

★ **STAND BACK:** The MythBusters Edit PM

popularmechanics.com September 2009

LIFTOFF!

Private Space
Flight Gets Real
p. 64

Popular Mechanics

Science Automobiles Technology Home

MythBuster Secrets

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Smartest Shortcuts

Jamie Hyneman
and Adam Savage
mod this magazine.

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ON THE COVER Shot at M5 Industries in San Francisco exclusively for PM by Joe Pugliese. Set building by Scene 2; prop styling by Claire Mack.

Popular Mechanics

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WHAT THEY'RE DOING



✕ DANIEL H. WILSON

Robotics, author of *Where's My Jetpack?* Often called upon for his knowledge of robots, Daniel Wilson recently started writing fiction: two books for children and a fairy tale featuring a cast of robots for young adults. After completing a season as host of *The Works* on the History Channel, the roboticist is now discussing concepts for a television show and has just finished a guide to the art of sibling smackdown, *Bro-Jitsu*, to come out early next year.





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Jamie Hyneman and Adam Savage meet the PM edit team.



Wow, this is a lot easier than shooting a TV show, Adam thinks as he reviews photos with editor-in-chief Meigs. The *MythBusters'* seventh season will air on the Discovery Channel Wednesdays at 9 pm EST/PST, starting in October.

Be My Guest (Editors)

IS THERE ANYTHING THESE GUYS CAN'T DO? When I invited Adam Savage and Jamie Hyneman to guest edit an issue of PM, I didn't know quite what to expect. But then, neither did they. As the stars of the Discovery Channel hit *MythBusters*, the pair spends a lot of time doing the same things we like to do: debunking junk science, building oddball contraptions, blowing stuff up ... And they've been regular contributors to PM for more than three years. So it seemed high time to conduct our own *MythBuster*-style experiment: Can two absurdly multitalented TV stars edit a magazine?

We began planning the project in the San Francisco offices of M5, Jamie's special-effects company. Later, Jamie joined the PM team to test motorcycles in Death Valley (page 70). Then Adam and Jamie met with the entire PM editorial staff in our New York offices. We discussed story ideas, looked over photo shoots, and asked for feedback on every part of the magazine. Boy, did we get it.

There might be some topic PM covers that neither Adam nor Jamie knows a frightening amount about—but if so, we didn't find it. You'll find their insights and editorial suggestions peppered throughout the issue.

For our cover story, PM's Larry Webster spent a few days working with both men, seeing their gonzo engineering methods firsthand.

About his day in our offices, Adam says: "When I picture a magazine, I imagine the avuncular editors leading a team of erudite, funny, quirky and attractive people in bright meeting rooms, with stimulating pictures on the wall, and evidence of advanced organization all over the place. The shocking thing was that your operation is exactly like that."

For his part, Jamie says, "I figured I'd have a corner office with a big desk at the Hearst Tower, and I could sit there smoking a cigar and fire people." Hey, maybe next time, Jamie. That's my job.

JIM MEIGS
Editor-in-Chief





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Space Online



NASA UPDATES PM has inside news and analysis on the fast-changing state of space exploration in the United States. NASA, in particular, is busy: There are a handful of launches left before the space shuttle retires; astronauts have repaired the Hubble Space Telescope for the last time; the Obama administration continues to mold plans for the future of manned space missions; and more rovers and probes are in the works.

popularmechanics.com/futurespace

TELESCOPES Astronomers have called this the "age of the exoplanet." Small, distant celestial bodies are being detected at a furious pace. New techniques, research and, especially, high-tech telescopes are being used to further the search for an Earth-like planet in our universe. Check in on the latest news from Kepler, Keck, Spitzer and the other top telescopes in our solar system.

popularmechanics.com/science

APOLLO 11'S 40TH BIRTHDAY To celebrate the 40th anniversary of the first moon landing POPULAR MECHANICS interviewed dozens of astronauts, flight controllers and engineers, who described their roles in humankind's most audacious adventure. "No Margin for Error," published in the June issue, now comes to life online with videos, audio and radio broadcasts never before heard in the U.S.

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TechWatch

Scrubbing Up to Explore Space

IN THE ICY NORTH, SCIENTISTS LEARN TO SANITIZE THEIR TOOLS BEFORE LOOKING FOR LIFE ON OTHER PLANETS. BY ALEX HUTCHINSON

→ When searching for life on a distant planet, it pays to make sure that any biologically derived molecules you find didn't catch a ride from Earth on the spaceship. Avoiding "forward contamination" takes elbow grease, and the right mix of chemicals, before a mission even launches. To test NASA's sterilization protocol, scientists set off for the Arctic archipelago of Svalbard with Cliffbot, a next-generation rover (shown here). There, they perfected a seven-step procedure involving distilled water, hydrogen peroxide and chemical swabs, making sure to scrub every one of Cliffbot's scoopers. The regimen worked, removing one more obstacle before cadres of squeaky-clean robots can further humanity's search for microbial company on Mars and the moons of Jupiter and Saturn.

Mars Mountaineer

+ Arctic Outdoor Lab
Scientists use Norway's far northern Svalbard islands to test gear-sterilization techniques and space-bound rovers such as this prototype.

+ Social Climber
Cliffbot is part of a three-rover team. Two other robots are tethered to the machine to let it access terrain as steep as 85 degrees.

+ Bot Specs
The rover is the size of a toy wagon, weighs nearly 18 pounds and creeps at 6 inches a second on level ground.



NEWS BRIEFS

Reports From the Edge of Science

• Compiled by Alex Hutchinson



New Drilling for Ultra-Deep Geothermal There is enough heat to produce near-endless power a few miles below Earth's surface, but it's expensive to access. Potter Drilling, a California-based startup company, says that within a year it will begin field trials of a technology that uses superheated water instead of conventional drills to bore through rock. Such a "hydrothermal spallation" system could drill through granite up to five times faster than conventional processes do.

encode a letter. A distant observer could detect the wavelengths of light emitted as the metals burn, and decipher the code.

KILLER ASTEROIDS—AND THE BUGS THAT LOVE THEM

✦ About 3.9 billion years ago a long barrage of asteroids, some as large as Kansas, pounded Earth and reshaped the surface of the planet. Scientists have long thought that the repeated impacts wiped out any existing life. Now, a new NASA-funded study by geologists at the University of Colorado at Boulder counters that the bombardment may have created a subterranean breeding ground for heat-loving microbes that flourish between 175 and 230 F. If they're right, life could date back 4.4 billion years, to when the first oceans are thought to have formed.

COLD TOMB FOR HOT WASTE

✦ While the U.S. government's two-decade, \$10 billion quest to build a long-term nuclear-waste repository in Nevada appears to be dead, other nations are pressing ahead with their own plans.

The Swedish Nuclear Fuel and Waste Management Company has been testing disposal technology at a 2.5-mile network of tunnels dug out of granite more than 500 yards below the surface on the island of Äspö. The spent fuel will be encapsulated in copper and embedded in bentonite clay, then placed in holes in the bedrock. The final site was selected in June; construction is scheduled to begin in 2016.



INSTANT DATE, JUST REMOVE WATER

✦ British researchers have given archaeologists a new way to find the age of artifacts when carbon-14 dating isn't an option. Rehydroxylation dating works with ceramics (such as the pottery shown here, from an excavated English theater) that gradually absorb water. Researchers weigh a sample, then heat it to boil off all moisture, then weigh it again to see how much water was removed. The scientists then expose the dried-out sample to water

vapor to check how fast the material soaks up moisture. Put all those data points together, and you can derive an estimate of when the sample was made. The technique has passed tests on 2000-year-old artifacts, and the researchers say it can work for objects up to 10,000.

NEW SMOKE SIGNALS

✦ A Defense Department research project has produced "infofuses" to help soldiers stay in touch when the power fails. Soldiers would light a fuse coated with metal dots that represent letters and numbers. Each dot contains a combination of lithium, rubidium and cesium to



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Hands-Free Farming

THE USE OF INTELLIGENT, UNMANNED MACHINES IS INCREASING IN AGRICULTURE. COULD ROBOTS END THE INDUSTRY'S ERA OF MIGRANT LABOR? BY ERIK SOFGE

➔ **Agricultural robots are already among us:** mowing grass, spraying pesticides and monitoring crops. For example, instead of regularly dousing an entire apple orchard with chemicals, towed sensors find diseases or parasites with infrared sensors and cameras, and spray only the affected trees. But could a robot wholly replace a migrant worker? The idea appeals to farmers, because temporary labor can arrive one season but go elsewhere the next, leaving tons of fruits and vegetables to wither. Relying on illegal immigrants can also be a legal liability. Harvesting is the most labor-intensive activity for many crops, but even advocates say that no one has built a machine that comes close to matching the sensory motor control of humans. That is poised to change as sensors and software become cheaper and more advanced. "In the next five years or so, we'll see robots out in the field," says Tony Stentz, associate director of Carnegie Mellon University's National Robotics Engineering Center. "And they'll lose their novelty. To the farmers, it'll just be another tractor, with no one in the cab."

Smart Gardeners

➔ Developed for a robotics class at MIT, autonomous gardeners use equipment mounted on the base of a Roomba. Sensors in the soil alert the robot, which waters plants and can use an articulated arm to pick any fruit it sees.

➔ **Prospects:** MIT staff have no immediate plans for commercialization, but they are continuing to create more autonomy in the bots. Future systems could compare earlier images of the same plants over time to detect diseases or parasites.



Self-Guided Farm Equipment

➔ Carnegie Mellon University's Field Robotics Center is testing an automated utility cart equipped with laser range-finders to find its way through a Pennsylvania apple orchard, towing sensors that track the progress of the crop.

➔ **Prospects:** The project is at least three years from completion. Researchers say the key to the future of industrial farm robots is keeping costs down by adapting existing commercial vehicles instead of building new ones.



Snippy the Grapevine Pruner

➔ Vision Robotics Vineyard Products designed Snippy to prune as many as 400 acres of grapevines per season, at around half the cost of manual labor. Mounted cameras create a 3D model to tell the bot's arms where to cut.

➔ **Prospects:** The first prototype pruner has been in field tests since March, and a second one should be operational by this fall. A majority of the project's funding comes from interested grape growers and vineyard owners, making Snippy an agbot pioneer.



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Serving the Public

San Francisco's high-tech bus stops will channel an estimated 43,000 kilowatt-hours per year into the city's grid. Built-in Wi-Fi routers will help the city create a comprehensive wireless Internet network.

Paying Its Way

Each bus stop costs about \$30,000. City officials say Clear Channel Outdoor has an installation and maintenance contract with the SFMTA. The company foots the bill and gets saleable ad space.

Conserving Juice

The new shelters' LED lights use 74.4 watts—four and a half times more efficient than the 336 watts used by the old shelters' fluorescent lighting.

The Secret Lives of Bus Stops

The sleek, undulating roofs of San Francisco's recently unveiled prototype bus stops are not just artistic flourishes. These street shelters use rooftop solar panels to power Wi-Fi routers and interactive information panels. Unused energy is pumped into the city's grid. By 2013 the San Francisco Municipal Transportation Agency plans to install 360 of the new stops around the city. — KYLE ROERINK



Armored vehicles in Afghanistan (above) guard against whirling bomb fragments, but do little to prevent brain damage.

Hard Lessons of Blasted Veggies

TO MEASURE THE EFFECTS OF SHOCK WAVES, RESEARCHERS ARE TURNING TO A LOW-TECH SOLUTION. BY CHRIS DIXON

→ **Armored vehicles** enable U.S. troops in Iraq and Afghanistan to survive roadside explosive attacks. But the shock waves from such blasts have left survivors with traumatic brain injuries. It is difficult to study how to mitigate these injuries: The lab dummies typically used in such research are good for measuring blunt trauma, but they are largely unaffected by the effects of shock waves, according

to Dr. Mark George, a neurologist at the Medical University of South Carolina. To measure such effects, George and vehicle manufacturer Force Protection used C-4 to blast Tupperware containing live celery suspended in gelatin. The veins of celery resemble the myelin sheath that carries impulses along human neurons. After each blast (left), the team analyzed the vegetables and discovered that they had tiny vascular tears that resembled damage in a brain suffering from shock-wave-induced trauma. The next step: integrating the findings into full-scale test dummies.

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Metamaterial Miracles

UNSATISFIED BY NATURE'S BOUNTY, SCIENTISTS CUSTOMIZE SUBSTANCES FOR BREAKTHROUGH TECHNOLOGIES. BY DAVID HAMBLING

→ When nature can't supply raw ingredients for next-generation hardware, scientists create their own. Man-made "metamaterials" are going beyond the lab and into real-world applications. Scientists use existing composite materials, like the gold and gallium-arsenide mixes used in electronics, to create complex, though tiny, structures. These nano-size bumps, crosses, holes or ridges manipulate electromagnetic waves that hit them. Early prototypes of invisibility cloaks, which would guide light around an object to be shielded, have generated some techno-buzz. But researchers have quietly been inventing more near-term materials that will soon appear in the pockets of consumers and in the hands of military users.



Super Cellphones

Rayspan Corp. of San Diego is using metamaterials to make stronger, smaller antennas. Although they measure just a few millimeters long and are as flat as paper, the new multiband antennas could double the range, reliability and battery life of cellular phones, Wi-Fi routers and wireless modems.

Availability: Already for sale, but the quality is expected to steadily improve over the next five years.



Everyday WMD Detectors

Army researchers are using metamaterials to build biological- and chemical-agent detectors. Metallic nanostructures react electromagnetically to incoming molecules, revealing their identities through a variety of responses. This method can detect single molecules, which could be of great use for passenger or cargo screening.

Availability: Possibly as little as five years for a working prototype.



Tools for the Silent Service

Sound has a larger wavelength than light, so it's easier to build metamaterials to manipulate it. An Office of Naval Research program is funding a prototype that bends sound around a submarine to make it invisible to enemy sonar. Civilian spinoffs could produce total soundproofing and rooms with perfect acoustics.

Availability: Five years to demonstrate acoustic cloaking in the lab; 10 years to the field.



Viewers of the Unseen

Microscope power is restricted by diffraction limit—anything smaller than about half the wavelength of the illuminating light can't be seen. A University of Michigan team created a lens with metallic resonators that focuses microwaves 10 times more than diffraction limit allows. These lenses could be used to make smaller, faster computer chips.

Availability: Optics could arrive within five years.



Revolutionary Electronics

Future circuits may use light rather than electricity, so Army engineers are building a metamaterial switching device, fundamental for building small, fast photonic equipment. The device combines a metamaterial with a semiconductor, so the ability to trap light can be turned on and off. Such photonic computer chips could be 10 times faster than current chips.

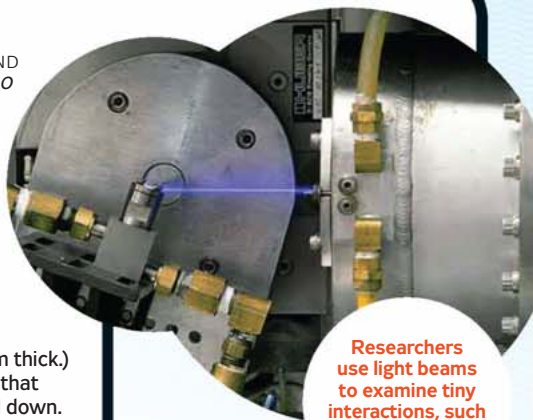
Availability: Components within five years; 10-plus years for a product.

PEERING INTO INVISIBLE WORLDS

A PARTICLE ACCELERATOR WILL PRODUCE THE WORLD'S BRIGHTEST LIGHT AND COULD REVOLUTIONIZE THE SCIENCE OF THE ULTRASMALL. BY JOE PAPPALARDO

+ **Workers have started construction** on a particle accelerator at Brookhaven National Laboratory in Long Island, N.Y. When the National Synchrotron Light Source II is completed, in 2015, it will be the world's most brilliant light source—10,000 times more powerful than the original NSLS, also located at Brookhaven. Electrons inside a ring with a half-mile circumference will accelerate to almost the speed of light, steered by massive magnets. Any charged particle that moves in a curved path emits electromagnetic radiation—X-ray, ultraviolet and infrared light that can be focused in beams that researchers use to illuminate experiments. Staff say the new \$912 million facility will achieve a record-setting single-nanometer resolution.

(For scale, the skin of a soap bubble is several hundred nm thick.) NSLS-II will shoot the beam through a series of magnets that have alternating poles, causing the beam to curve up and down. Every time the beam bends, the light is amplified.



Researchers use light beams to examine tiny interactions, such as the infiltration of HIV into healthy cells.



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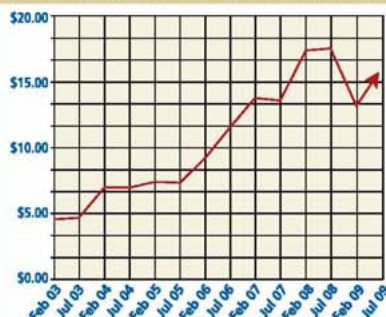
- Walking Liberty Half Dollar (1916-1947)
- Franklin Half Dollar (1948-1963)
- Kennedy Half Dollar (1965-1970)
- Roosevelt Dime (1946-1964)
- Washington Quarter (1932-1964)
- Mercury Dime (1916-1945)
- Barber Dime (1892-1916)

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Price of Silver on the Rise



Silver Trend Chart: Prices based on monthly averages. ©AMS, 2009.



Coins shown larger than actual size

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Upgrade

Born to Rung

➔ Ladder-related injuries send more than a half-million people to the hospital every year. The *Little Giant BigTrex 6-foot Stepladder* (\$158) features a number of clever features designed to keep homeowners out of the ER. Its extra-wide treads are easy to balance on, the hinge is designed to keep from snagging fingers, and—this is our favorite feature—a raised tray allows you to dip brushes and grab tools without bending into precarious positions. — SETH PORGES

1. The 6.5-inch-deep rungs are easier and more comfortable to balance on.

2. The tool and paint tray rises to waist height when you're working near the top rung.

EDITOR'S
CHOICE



Test Drive

POGOPLUG



→ The **Cloud Engine Pogoplug** (\$100) promises to turn what was once an obscure magic trick for the geek elite—accessing a hard drive full of music, images and documents from any PC in the world—into a novice maneuver. Connect the device to your modem and plug in a hard drive, and after a few mouse clicks, your data is online. We were impressed with the clean interface, lack of monthly fees and effortless data security.



Dial Fit

→ No two pairs of feet share the same size, shape and way of moving. But despite this fact, shoemakers typically renounce nuance and instead boil foot differences down to a single shoe-size number. The insole on the Gore-Tex-protected **Wolverine iCS Hiker** (\$160) features a removable dial that allows users to adjust the shoe's under-heel stiffness. Sure, it's kind of gimmicky, but for heavy pronators (like a few of our in-house testers), the ability to adjust the boot's cushion could prove useful for long hikes.



Turning Keys

→ E Ink is a technology with a lot of promise, but slow refresh rates and a lack of color (at least for now) leave it with few practical applications outside the world of e-book readers. The **Samsung Alias 2** (\$200 with contract) takes a novel approach: building E Ink into the phone's buttons. Depending on which way you flip open the screen—vertically for phone dialing, horizontally for texts and e-mails—the keys display either numbers or a qwerty keyboard.



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Abusive Lab Test

SAFETY GLASSES

→ The goal of most safety glasses is fairly modest: Protect eyes from impacts. But considering their rigorous testing regime—a steel ball is fired at the lenses at 300 feet per second, and a free-falling needle is dropped onto them from height—we figured they must be able to stand up to more abuse than their packaging claims. We took three pairs of \$4 safety glasses and set out to see exactly what they could do. — SETH PORGES

AO Safety Glasses ✕



MSA Safety ✕



Jackson Safety ✕

SCOUR IT

To test visibility after years of use, we scoured the lenses with a power-driven wire brush.

Almost instantly, the spinning brass wire scraped away all of the lenses' visibility. But the plastic proved an impermeable barrier: Even when the power driver spun the brush at full power, no bristles could get through to the head behind.

STAPLE IT

To simulate high-speed impacts from sharp objects, we shot a staple gun at the lenses.

A staple gun can fire rounds at 70 inch-pounds. That proved no match for our plastic glasses—all three of which stopped a full roll of steel staples shot at point-blank range. And while every fifth or so staple ended up embedded in the lenses, not one shot fully penetrated the plastic, and our mannequins' eye areas remained unharmed.

DRILL IT

To represent a power tool gone awry, we used a drill on the lenses.

Stray swipes of our power drill proved no problem for the lenses—it took several seconds of concentrated drilling to puncture the plastic, something that is highly unlikely to occur by accident.

MELT IT

To produce a high-heat environment, we took aim with a 1000-degree heat gun.

None of our safety glasses were designed to serve as a heat shield, but we couldn't resist seeing how they handled 1000 degrees F. Within seconds, the foam faces began to melt, *Raiders of the Lost Ark*-style. Soon after, the plastic lenses turned to jelly, before hardening into sharp points. But by then, our mannequins had little face left to poke.

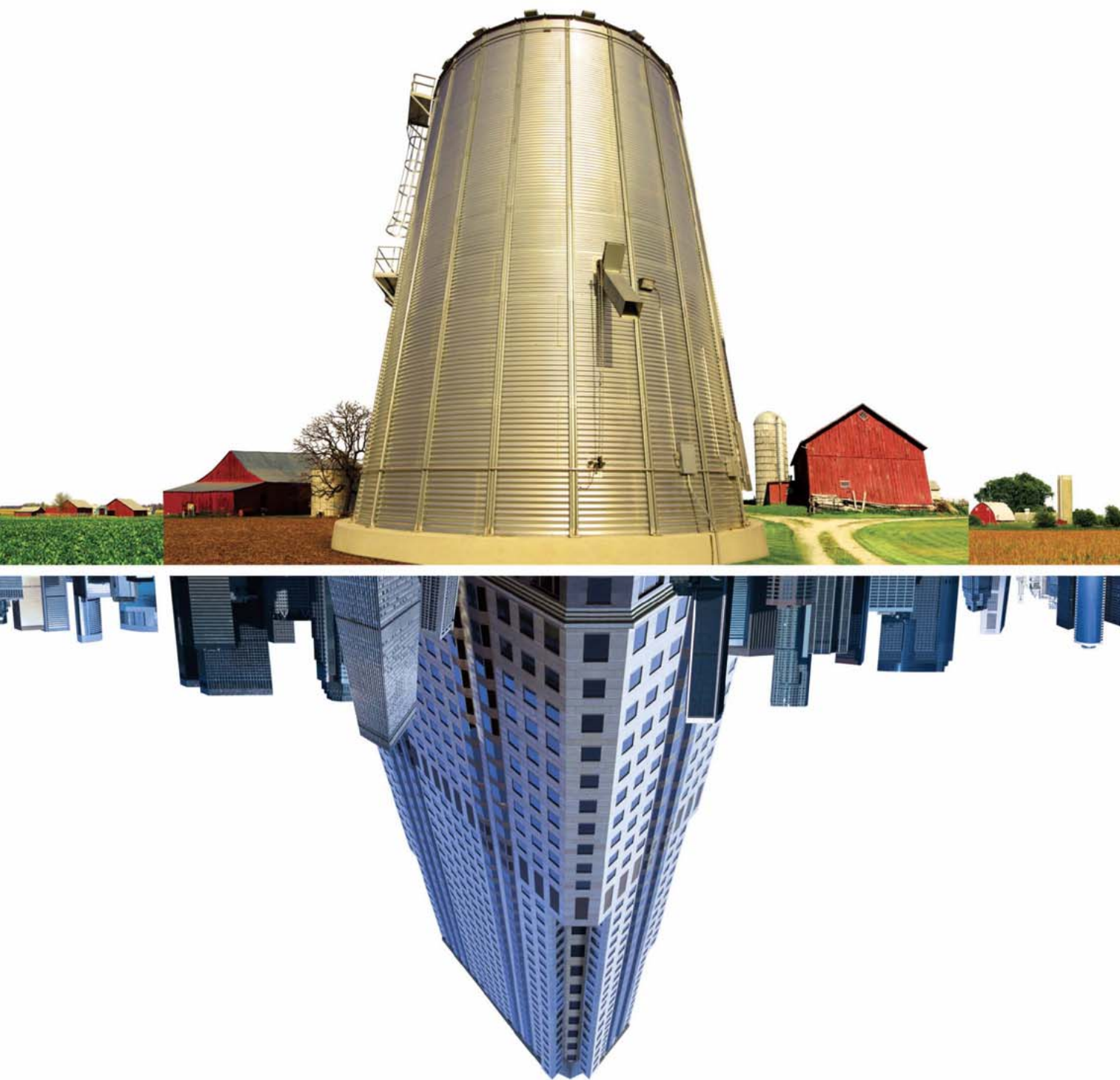
BOTTOM LINE

All three models did exactly what they claimed to do, providing an impressive amount of protection against impacts. Safety glasses cost \$4. Reconstructive surgery costs much more.

ON THE WEB >

For this test, PM teamed up with Josh Zepps, host of the Science Channel's *Brink*, for an episode to air Aug. 17 at 10:30 pm EST. You can see the test video at popularmechanics.com/abusivelabtest.





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Save Money. Smell the Flowers.

Looking for ways to save money on gas and help the environment? The EPA wants to share some smart driving tips that could give you more miles per gallon of gas and reduce air pollution. Tips like making sure your tires are properly inflated and replacing your air filter regularly. And where possible, accelerate and brake slowly. Be aware of your speed...did you know that for every 5 miles you go over 65 mph, it's as if you're spending 20 cents more per gallon of gas? If you're shopping for a new car, look for the SmartWay® certification mark to help you choose the cleanest, most efficient vehicle that meets your needs. If we each adopt just one of these tips, we'd get more miles for our money and it would be a little easier to smell the flowers. For more tips and to compare cleaner, more efficient vehicles, visit www.epa.gov/smartway.



Combination Lock and Load

→ Power-tool grab bags like the new Rockwell 18-Volt Lithium-Ion ComPack Combo Kit (\$250) are the top sellers for most cordless tool manufacturers, but the slew of drivers, saws and flashlights—there's always that little flashlight!—can cost some serious scratch. That's why we're glad to welcome this new drill/driver and impact driver combo. No bells and whistles, no fancy freebies, just a solid pair of 21st-century power tools at a decent

price. When we held one tool in each hand, gunslinger-style, drilling and driving 1/4-inch pilot holes to sink 2-inch lagbolts, the compact batteries kept kicking, and the tools just hummed. And that's all we ask.

Disc Over

→ Sony is notorious for letting bad proprietary-media formats ruin good technology. One of the worst offenders: the bulky and expensive UMD disc. But until recently, these discs were the only legit way to acquire PSP games. The new PlayStation Portable Go (\$250), which comes out in October, finally sheds the years-old system's UMD drive—along with about half of the older model's weight and bulk. Instead, it has 16 gigabytes of built-in memory and the ability to download full PSP games directly to the device via Wi-Fi.



Apple's New Core

→ Externally, the new Apple iPhone 3GS (\$200 to \$300 with a new contract) is pretty much identical to last year's iPhone 3G (which is still on the market for the bargain-basement price of \$99). But under the hood, a lot has changed. The new model packs in more memory, a faster processor and, for the first time, the ability to shoot video. Is this enough to warrant an upgrade if you've already got an older iPhone? Probably not. The price tag is hundreds higher if you're not a new AT&T customer, and a number of new features can be had for free just by downloading the new iPhone 3.0 operating system. But if you've been waiting to jump into the iPhone pool, this could be the time to take the plunge.



Test Drive

SPEEDCLEAN
BUCKETVAC

→ Spare 5-gallon buckets can be used as stilts, stools, trash cans—and now shop vacs. That's the idea behind the **SpeedClean BucketVac** (\$70), a 1-hp vacuum head that snaps onto any standard 5-gallon bucket, creating a high-power wet/dry vac capable of moving 30 gallons of water per minute (in tests, it filled its receptacles in about 5 seconds). And the upsides are numerous: Not only is this device far easier to stash and store than full-size shop vacs (which also tend to be uncomfortably heavy), but we can easily see it being the preferable option for clearing flooded basements, bucket-brigade-style.

how we tested

Imagine the aftermath of a party in the toolshed—during a flood. We sucked up small nails, drywall screws, cheese puffs and cereal. Then, we slurped gallons of water from one bucket to the next.



Crossover Cutter

→ Casual users may not be aware of the debate, but the circular saw is the subject of longtime regional loyalties. House framers in the West tend to prefer robust worm-drive saws, while Eastern tradesmen tend toward the lightweight sidewinder style. The **Skil HD5687** (\$150) is a 7¼-inch, 15-amp "sierra circular" that combines the features of both. It keeps the weight to a manageable 10.8 pounds with a sidewinder motor and housing, but uses the slim profile and handle/switch geometry of the worm drive. Call it the wormwinder.



Playing Tag

→ Geotagging—that is, tagging photos with the longitude and latitude of where they were taken—can make pictures more fun, more personal and more useful (you can easily backtrack to that ideal spot with the perfect view). The **Garmin Oregon 550T** (\$600) makes the process automatic and easy—it's a rugged, waterproof, outdoor-friendly touchscreen GPS with a built-in 3.2-megapixel camera and a 4x optical zoom.

Small Body, Big Brain

→ Digital photography is all about tradeoffs. Digital SLRs offer superior control and the flexibility of interchangeable lenses, but are too bulky to slip into a pocket. The 12.3-megapixel **Olympus E-P1** (\$800 with lens) migrates an SLR's innards (including a large image sensor) and lens-swapping ability into a svelte, compact chassis. And externally, the camera is a retro-fetishist's dream: The body comes straight from the classic Olympus Pen series cameras of the late 1950s.



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There are cars designed for fuel efficiency and there are cars designed for luxury. But until now, there hasn't really been a car that excels in both arenas. The new Lexus HS 250h could be it. Under the hood is the 2.4-liter hybrid powertrain of the Camry Hybrid. And the HS has both Eco and EV modes, which allow the car to travel at speeds of up to 20 mph for a couple of miles under pure electric power. The interior is posh, techy and cool, while the firm suspension helps move this car into the realm of sport luxury sedan. No, the HS is not quite as smooth-riding or substantial-feeling as other Lexuses. But it will return a solid 35 mpg city and 34 on the highway. And for many, that could be the tipping point. — JAMES TATE



2010
Lexus HS 250h
Base Price (Est.) \$35,000

INSIDE

Ford
Transit Connect
Acura
TSX V6
Chevy
Corvette
Mercedes-Benz
S400 Hybrid
Chevy
Volt Prototype

COMPARISON

Ford Taurus SHO
vs. Chrysler 300C

PLUS

After the Bailout



PM

TEST DRIVEN

+
PM TEST
DRIVEN
+→ LEXUS HS 250h | FORD TRANSIT CONNECT | ACURA TSX V6 | CHEVY CORVETTE |
MERCEDES-BENZ S400 HYBRID | CHEVY VOLT PROTOTYPE | FORD TAURUS SHO vs. CHRYSLER 300C X

1 2010 Ford Transit Connect

Mini Mover

We are navigating the narrow streets of Alexandria, Va., to test the mettle of the Transit Connect in a cramped urban environment. The van's goofy high roof and billboard-like slab sides might have repelled shoppers a decade ago. But American sensibilities have evolved. And so Ford imported its fuel-efficient commercial delivery truck from Europe. A tiny 136-hp 2.0-liter is matched to a four-speed automatic, so don't expect sprightly thrust in this 3470-pound trucklet. The high driving position and tall windows create superb forward visibility, and optional rear backup sensors aid parallel parking. The \$21,475 van gets 22 mpg city and 25 mpg highway—two factors that should help attract a new commercial crowd. —DAN CARNEY

—
The Transit provides 135 cubic feet of hauling volume and a 1600-pound payload. A suite of computerized work gadgets are available, such as Tool Link, which builds RFID sensors into the van. At the press of a button, the driver can see an inventory of all the tagged tools aboard and compare it against prepared lists.

2 2010 Acura TSX V6

Power Source

As poised as the four-cylinder Acura TSX is, a quick scan of the spec sheet would probably send torque junkies to more powerful pastures. That car has just 170 lb-ft—not exactly the stuff of our quarter-mile dreams. Acura decided the TSX needed a bit more muscle, so the company shoehorned in the 280-hp V6 from the larger TL. Plant your right foot in a four-cylinder TSX and you'll wait until the tach hits high noon before you feel the grunt of the motor. But the \$35,660 V6 model leaves the line with a torquey thrust as the steering wheel dances in your grip ever so slightly. On our drive through the Santa Monica Mountains, the steering felt heavier and a touch quicker too. Bend into a gentle sweeper and this sedan generates smiles. The V6 experience is also more serene than in the base TSX—this Six is deliciously smooth. —BEN STEWART



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→ LEXUS HS 250h | FORD TRANSIT CONNECT | ACURA TSX V6 | CHEVY CORVETTE |
 MERCEDES-BENZ S400 HYBRID | CHEVY VOLT PROTOTYPE | FORD TAUNUS SHO vs. CHRYSLER 300C X

1



2



1 2009 Chevy Corvette

Fast and Frugal

Its thrilling brothers the Z06 and the ZR1 have hogged the Corvette spotlight, but the \$49,515 base model has the greatest range of talents. It's blisteringly quick and mild-mannered around town, and it holds plenty of luggage. Most amazing of all, the base Corvette is good for 16 mpg city and 26 mpg highway. So could we stretch that economy with a feathery touch on the throttle? We borrowed a Corvette coupe equipped with the six-speed manual, chose a section of Highway 101 north of Santa Barbara, Calif., unlikely to be crammed with traffic, and set out to eke every last mpg out of this world-class sports car. We ran at 55 mph with cruise control for about 150 miles. Back at the pump, we refueled and saw 32.8 mpg. That's 32.8 mpg from a sports car that will top out at over 190 mph. Impressive.

— JOHN PEARLEY HUFFMAN

—
It's no secret how the Corvette returns such great mileage. The car has an impressive drag coefficient of 0.28. And the sixth gear ratio of 0.50:1 overdrive when combined with the 3.42:1 axle allows the engine to turn very slowly at modest cruising speeds. The result is fuel economy that can hit the 30s.

2 2010 Mercedes-Benz S400 Hybrid

Breakthrough Tech

The new S400 Hybrid is the first series-production car to use lithium-ion batteries—an energy-dense design automakers see as the future standard for electric vehicles. The S400 runs an Atkinson-cycle (a longer expansion cycle for optimal efficiency) 275-hp 3.5-liter V6 paired to a slim, disc-shaped AC electric motor that fits neatly between the engine and the seven-speed automatic. When called upon, the electric motor adds 20 hp and 118 lb-ft of torque. Since the combined motivation adds up to almost 300 hp, acceleration is brisk for the 5 seconds of full assist the electric motor provides. Driven sanely, the \$90,000 S400 will return 23 mpg city and 33 on the highway. Not bad for a 4500-pound luxury car. — BARRY WINFIELD

Clauss® SpeedPak™ Utility Knife Instructions

STEP-1

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Titanium Cartridge

STEP-2

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x **Early
Drive**

Plug-in Volt

The Chevy Volt is perhaps the most anticipated vehicle in GM's long history. And with around 18 months left before the plug-in hits showrooms, we had a chance to slide behind the wheel of a prototype at GM's Warren Tech Center. On our drive, GM disabled the car's internal-combustion engine and charging system. But that's okay, because the car moves entirely on electric power at all times. The gas engine is used to sustain the charge. The Volt may be a radical departure from traditional automotive engineering, but driving the test mule proved remarkably unremarkable. It was like any common sedan. Besides its silence, the Volt gives no clue of the underlying tech. The Volt did feel heavy, thanks to four people onboard and a host of test gear. But the propulsion is as liquid-smooth as the latest luxury sedans'. — KEVIN A. WILSON



The Volt's drivetrain uses a 120-kilowatt AC induction electric motor that generates 273 lb-ft of torque. It draws power from a 16-kwh pack of more than 200 lithium-ion cells. The Volt can travel 40 miles on a full charge, before the 1.4-liter range-extending gasoline engine begins to charge the pack.

+
PM TEST
DRIVEN
+

→ LEXUS HS 250h | FORD TRANSIT CONNECT | ACURA TSX V6 | CHEVY CORVETTE |
MERCEDES-BENZ S400 HYBRID | **CHEVY VOLT PROTOTYPE** | FORD TAURUS SHO vs. CHRYSLER 300C x

2010 Chevy Volt Prototype



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Domestic Throwdown

THE V6 FORD TAURUS SHO TAKES ON THE V8 CHRYSLER 300C. CAN TWIN TURBOS TOPPLE A HEMI? BY LARRY WEBSTER



Ford Taurus SHO

VS.

Chrysler 300C

Comparison

Chrysler 300C

\$46,860
5.7-liter V8/5A
360 @ 5000 rpm
5.5 sec
13.9 sec
@ 100 mph
126.2 ft
20.7 mpg

TESTED PRICE
ENGINE/TRANS
HORSEPOWER
0-60 MPH
QUARTER-MILE

60-0 BRAKING
FUEL ECONOMY

Ford Taurus SHO

\$45,470
3.5-liter V6/6A
365 @ 5500 rpm
5.4 sec
13.7 sec
@ 102 mph
117.6 ft
21.8 mpg

← ↓ →

the SPECS

Ford claims the new Taurus SHO and its twin-turbo 3.5-liter V6 provide the power of a V8 with the fuel economy of a V6. We're skeptical, because past turbo motors were notoriously thirsty. But improved turbocharger technology and direct fuel injection suggest Ford might have the hardware to back up this claim. To test the SHO and its fuel-saving potential, we lined up the perfect foil, a Chrysler 300C AWD. Dimensionally, the Chrysler is within inches of the Ford, shares all-wheel drive and has only five fewer ponies. A big 5.7-liter V8, however, rests behind that gangsta grille. So to help boost the Hemi's fuel economy, a multi-displacement system automatically shuts off four cylinders when they're not needed. Both pencil out right around 45 grand. So let's see how they match up.

the DRIVE

In just two days, we ran a four-state, 1000-mile odyssey. We covered plenty of highway miles, city stints and a good flogging on our favorite back roads—strictly for test purposes, of course. Consecutive 12-hour days in the saddle would have been punishing if these two were not both exceedingly comfortable sedans. They're both quiet too, but the overall edge goes to the SHO. The Ford is not only a tick quicker on the dragstrip; it's also devoid of turbo lag—it delivers smooth, uninterrupted thrust. Each of these cars weighs more than 2 tons, yet they're more willing to change direction than you'd expect. In the twistiest turns, the 300C felt livelier, but the SHO required fewer midcourse corrections and cornered flatter. The SHO's brakes, however, faded quickly. Our advice? Get the optional performance pads.

BOTTOM LINE

After burning through three tankfuls, the tale at the pump became clear. Overall, the SHO returned 5.5 percent better fuel economy. We can't credit the turbo engine entirely (the SHO's gearbox has an extra gear), but it's certainly a contributing factor. Quicker and more efficient? The Ford Taurus SHO wins.

PM TEST
DRIVEN

→ LEXUS HS 250h | FORD TRANSIT CONNECT | ACURA TSX V6 | CHEVY CORVETTE |
MERCEDES-BENZ S400 HYBRID | CHEVY VOLT PROTOTYPE | FORD TAURUS SHO vs. CHRYSLER 300C X



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- 2. Maintaining an erection**
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Talk with your doctor first. Make sure your heart is healthy enough to have sex. If you have chest pain, nausea, or other discomforts during sex, seek medical help right away. As with any ED tablet, in the rare event of an erection lasting more than four hours, seek immediate medical help to avoid long-term injury.

In rare instances, men taking PDE5 inhibitors (oral erectile dysfunction medicines, including VIAGRA) reported a sudden decrease or loss of vision, or sudden decrease or loss of hearing. It is not possible to determine whether these events are related directly to these medicines or to other factors. If you experience any of these symptoms, stop taking PDE5 inhibitors, including VIAGRA, and call a doctor right away.

The most common side effects of VIAGRA are headache, facial flushing, and upset stomach. Less common are bluish or blurred vision, or being sensitive to light. These may occur for a brief time. VIAGRA does not protect against sexually transmitted diseases including HIV.

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IMPORTANT FACTS

VIAGRA®
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(vi-AG-rah)

IMPORTANT SAFETY INFORMATION ABOUT VIAGRA

Never take VIAGRA if you take any medicines with nitrates. This includes nitroglycerin. Your blood pressure could drop quickly. It could fall to an unsafe or life-threatening level.

ABOUT ERECTILE DYSFUNCTION (ED)

Erectile dysfunction means a man cannot get or keep an erection. Health problems, injury, or side effects of drugs may cause ED. The cause may not be known.

ABOUT VIAGRA

VIAGRA is used to treat ED in men. When you want to have sex, VIAGRA can help you get and keep an erection when you are sexually excited. You cannot get an erection just by taking the pill. Only your doctor can prescribe VIAGRA.

VIAGRA does not cure ED.

VIAGRA does not protect you or your partner from STDs (sexually transmitted diseases) or HIV. You will need to use a condom.

VIAGRA is not a hormone or an aphrodisiac.

WHO IS VIAGRA FOR?

Who should take VIAGRA?

Men who have ED and whose heart is healthy enough for sex.

Who should NOT take VIAGRA?

- If you ever take medicines with nitrates:
 - Medicines that treat chest pain (angina), such as nitroglycerin or isosorbide mononitrate or dinitrate
- If you use some street drugs, such as "poppers" (amyl nitrate or nitrite)
- If you are allergic to anything in the VIAGRA tablet.

BEFORE YOU START VIAGRA

Tell your doctor if you have or ever had:

- Heart attack, abnormal heartbeats, or stroke
- Heart problems, such as heart failure, chest pain, or aortic valve narrowing
- Low or high blood pressure
- Severe vision loss
- An eye condition called retinitis pigmentosa
- Kidney or liver problems
- Blood problems, such as sickle cell anemia or leukemia
- A deformed penis, Peyronie's disease, or an erection that lasted more than 4 hours
- Stomach ulcers or any kind of bleeding problems

Tell your doctor about all your medicines. Include over-the-counter medicines, vitamins, and herbal products. Tell your doctor if you take or use:

- Medicines called alpha-blockers to treat high blood pressure or prostate problems. Your blood pressure could suddenly get too low. You could get dizzy or faint. Your doctor may start you on a lower dose of VIAGRA.
- Medicines called protease inhibitors for HIV. Your doctor may prescribe a 25 mg dose. Your doctor may limit VIAGRA to 25 mg in a 48-hour period.
- Other methods to cause erections. These include pills, injections, implants, or pumps.

POSSIBLE SIDE EFFECTS OF VIAGRA

Side effects are mostly mild to moderate. They usually go away after a few hours. Some of these are more likely to happen with higher doses.

The most common side effects are:

- Headache
- Feeling flushed
- Upset stomach

Less common side effects are:

- Trouble telling blue and green apart or seeing a blue tinge on things
- Eyes being more sensitive to light
- Blurred vision

Rarely, a small number of men taking VIAGRA have reported these serious events:

- Having an erection that lasts more than 4 hours. If the erection is not treated right away, long-term loss of potency could occur.
- Sudden decrease or loss of sight in one or both eyes. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. They may be caused by conditions like high blood pressure or diabetes. If you have sudden vision changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Sudden decrease or loss of hearing. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. If you have sudden hearing changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Heart attack, stroke, irregular heartbeats, and death. We do not know whether these events are caused by VIAGRA or caused by other factors. Most of these happened in men who already had heart problems.

If you have any of these problems, stop VIAGRA. Call your doctor right away.

HOW TO TAKE VIAGRA

Do:

- Take VIAGRA only the way your doctor tells you. VIAGRA comes in 25 mg, 50 mg, and 100 mg tablets. Your doctor will tell you how much to take.
- If you are over 65 or have serious liver or kidney problems, your doctor may start you at the lowest dose (25 mg).
- Take VIAGRA about 1 hour before you want to have sex. VIAGRA starts to work in about 30 minutes when you are sexually excited. VIAGRA lasts up to 4 hours.

Don't:

- Do not take VIAGRA more than once a day.
- Do not take more VIAGRA than your doctor tells you. If you think you need more VIAGRA, talk with your doctor.
- Do not start or stop any other medicines before checking with your doctor.

NEED MORE INFORMATION?

- This is only a summary of important information. Ask your doctor or pharmacist for complete product information OR
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"During my many years as a jeweler, examining an astonishing 20 ctw emerald necklace certainly is a rare treat. The Stauer Emerald in Gold Necklace is as good as it gets."

**— JAMES T. FENT, Stauer
GIA Graduate Gemologist**

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It happened on our last trip to South America. After visiting the "Lost City" of Machu Picchu in Peru, we ventured through the mountains and down the Amazon into Brazil. In an old village we met a merchant with an impressive collection of spectacular, iridescent emeralds. Each gem was tumbled smooth and glistened like a perfect rain forest dew drop. But the price was so unbelievable, I was sure our interpreter had made a mistake.

But there was no mistake. And after returning home, I had 20 carats of these exquisite emeralds strung up in 14k gold and wrapped as a gift for my wife's birthday. That's when my trouble began. She loved it. Absolutely adored it. In fact, she rarely goes anywhere without the necklace and has basked in compliments from total strangers for months now.

So what's the problem? I'm never going to find an emerald deal this good again. In giving her such a perfect gift, I've made it impossible to top myself.

To make matters worse, my wife's become obsessed with emeralds. She can't stop sharing stories about how Cleopatra

cherished the green gem above all others and how emeralds were worshiped by the Incas and Mayans and prized by Spanish conquistadors and Indian maharajahs. She's even buying into ancient beliefs that emeralds bring intelligence, well-being and good luck to anyone who wears them. I don't have the heart to tell her that I'm never going to find another deal this lucky.

Our elegant Emeralds in 14K Gold Necklace features 20 carats of smooth, round emerald beads, hand-wired together with delicate 14K gold links. Each bead is unique in both size and color, ranging from transparent to translucent. The 18" necklace fastens with a spring ring clasp. If you are not thrilled at this rare find, send it back within 30 days for a full



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After the Bailout

GM EMERGES FROM BANKRUPTCY A LEANER COMPANY WITH SOME PROMISING TECHNOLOGY IN THE WORKS. BUT IS THE FUTURE REALLY AS BRIGHT AS THE COMPANY CLAIMS? BY BEN STEWART

For General Motors, the worst is over—maybe. The once-sprawling company is down to four brands. It's axed nearly half its dealer base, shrunk its workforce and successfully thrown itself at the mercy of the American taxpayer. It's a sign of just how bad things were at the lumbering giant that analysts regarded all that as the good news.

The question is, What comes next? Now that the company has emerged from bankruptcy, GM insiders are promising a Lazarus act, in which the company roars back to life—or at least stands on its own feet. "We are going to be able to break even at earnings before interest and taxes [when the U.S. auto industry reaches]

about 10 million units," Tom Stephens, GM's vice chairman of global product development, says.

Assuming the market returns to pre-crash sales levels, the arithmetic looks better than that. "Once it gets back to 13 to 14 million units, you will see profits like we haven't seen in this industry for a long time," David Cole, chairman of the Center for Automotive Research, says.

Ironically, General Motors could end up in a healthier position than the only big U.S. automaker that stayed out of chapter 11 this year. Soon, GM will be "operating at a far more

advantageous cost-to-manufacture position than Ford," according to Jim Hall, managing director for consulting firm 2953 Analytics. And why not? GM unloaded billions in liabilities (along with many shareholders) in bankruptcy court, and the government is dropping \$50 billion more into the company's outstretched palm.

New Vehicles Positive forecasts

assume, however, that GM's vehicles can attract drivers. Will Americans buy from a company that couldn't keep its own corporate wheels turning? Perhaps. The company's factories—those not among the 13 being shut down or idled—will soon be turning out some appealing vehicles. GM plans to expand the use of its

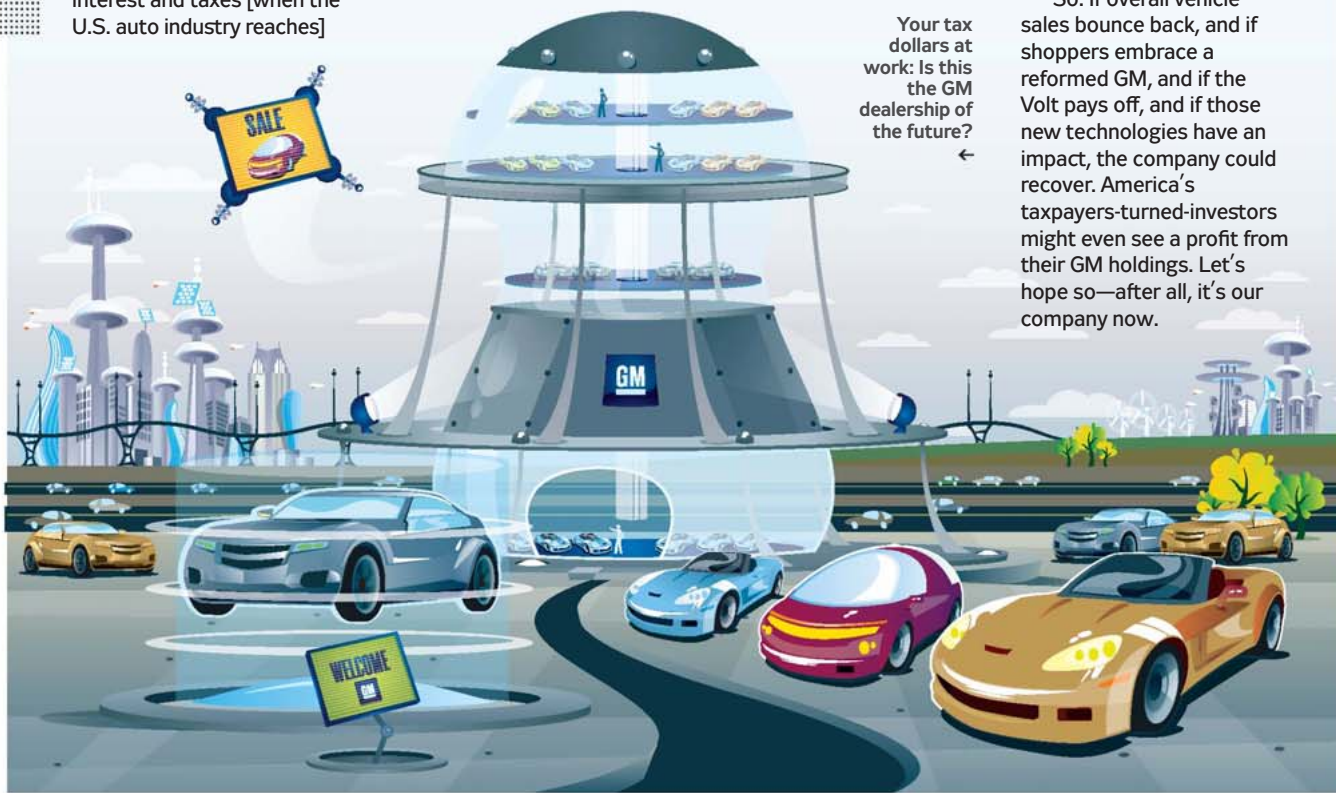
two-mode hybrid system and introduce both the Chevrolet Volt, a plug-in hybrid (see page 36 for an early test drive), and a Cadillac version of the vehicle. Stephens says the company should start building Volts in late 2010.

But one line of cars, no matter how innovative, won't save GM—or return those billions to the federal balance sheet. Stephens insists that more advanced technologies are in the works: "I have not taken any of them off the table," he says. Hall, for one, believes him: "They've tried to cut as little out of engineering and design as possible."

Will the emphasis on green tech mean the end of cars that are fun to drive? Will the V8 engine survive? Stephens says yes. "Bottom line: You will still be able to purchase performance vehicles from GM."

So: If overall vehicle sales bounce back, and if shoppers embrace a reformed GM, and if the Volt pays off, and if those new technologies have an impact, the company could recover. America's taxpayers-turned-investors might even see a profit from their GM holdings. Let's hope so—after all, it's our company now.

Your tax dollars at work: Is this the GM dealership of the future? ←

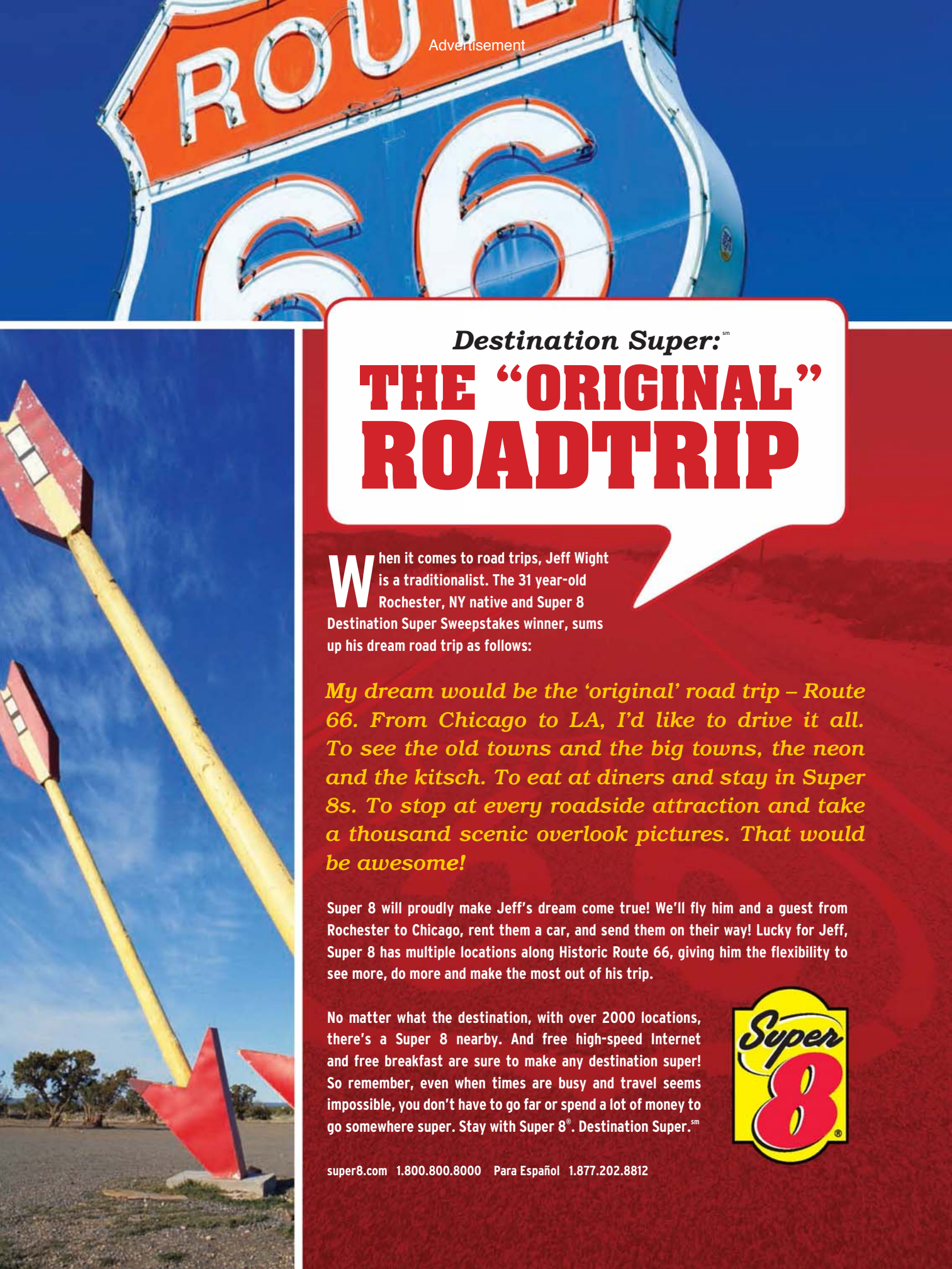




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**THE “ORIGINAL”
ROADTRIP**

When it comes to road trips, Jeff Wight is a traditionalist. The 31 year-old Rochester, NY native and Super 8 Destination Super Sweepstakes winner, sums up his dream road trip as follows:

My dream would be the ‘original’ road trip – Route 66. From Chicago to LA, I’d like to drive it all. To see the old towns and the big towns, the neon and the kitsch. To eat at diners and stay in Super 8s. To stop at every roadside attraction and take a thousand scenic overlook pictures. That would be awesome!

Super 8 will proudly make Jeff’s dream come true! We’ll fly him and a guest from Rochester to Chicago, rent them a car, and send them on their way! Lucky for Jeff, Super 8 has multiple locations along Historic Route 66, giving him the flexibility to see more, do more and make the most out of his trip.

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KEEP IT REAL

> BY JAMIE HYNEMAN

> ILLUSTRATION BY JOSH COCHRAN



THIS MYTHBUSTER THINKS COMPUTER DESIGN IS NO SUBSTITUTE FOR HANDS-ON EXPERIENCE.

Note the word “aided” in the name, though. Computers don’t do the designing; engineers and designers do. If people don’t bring good stuff to the project, the results will usually not be good. The problem isn’t “junk in, junk out.” Even if you start out with a junk concept, CAD can help generate something that works. It may be overly complicated and impractical to build or service, but it can still be functional. This is a classic example of the killing-snakes-with-a-shovel school of design, where you figure out solutions to problems as they

arise, instead of becoming familiar with and internalizing the project as a whole first, and then coming up with a clean, elegant design.

We ran into a problem like this on the show. I needed to change the battery on a car we were using to run some tests. Because the cooling system and other hardware were located over the battery, I had the choice of removing the right front wheel and inner fender or dismantling the cooling system to get to the battery. This wasn’t an exotic car that you might expect to have some impractical aspects. This was your average American midsize sedan. I decided to remove the wheel, and it took me about 10 times longer to

These days, CAD—or computer-aided design—touches nearly every aspect of our lives, from the cars we drive to the tools we use. These graphics programs enable engineers and designers to create parts or entire machines in the virtual world of the computer before building them in the physical world. CAD is one of the most important inventions of our time—a powerful tool for testing materials, experimenting with configurations and, ultimately, turning ideas into reality.

I boot up CAD programs regularly for builds on *MythBusters*, and consider them to be indispensable tools. For one episode, I used SolidWorks CAD software to analyze a seesaw design with a lightweight but extremely complex truss structure. That seesaw ended up withstanding a 100,000-foot-pound force, and yet I could pick it up and walk around with it.

replace the battery than it should have. I was astonished—the person who designed that car clearly had never changed a battery. The battery fit in CAD, and it fit in the car, but what was an elegant fit in the computer was a problem in the real world. I can just see the designer in front of his computer stuffing the car's components into available spaces without a clue as to what he was doing.

To my way of thinking, an engineer's work is better if he has a foundation of hands-on experience. If he has memories of his own blood smeared on his tools, his approach to a mechanical problem will be different than if most of his insights arise while sitting in front of a computer.

Let's look at a staple of home-repair toolboxes: the pipe wrench. You just *know* it was designed by a guy who needed to get a job done in close quarters, and it was based on bleeding knuckles. The jaw is at 90 degrees to the handle, which is unlike any standard wrench. The heft of the tool, the rounded shapes of the pieces—all of these features were informed by users with years of experience in the field. And there's a great deal of slop—loose tolerances of all the moving parts—so that the wrench still works with rust, dirt and gunk all over it. The slop also means that the more torque you apply, the more the components shift, and the tighter the jaws bite into the pipe. Sometimes slop is our friend, but I've never seen it on a pull-down menu.

Extremely complex designs, such as those for airliners, do benefit from CAD. The software is well-suited for focusing on individual parts and refining them—how thin can you make this component

AN ENGINEER'S WORK IS BETTER IF HE HAS MEMORIES OF HIS OWN BLOOD SMEARED ON HIS TOOLS.



without it breaking? You run a finite element analysis on it and see that you need to make it a little thicker here, but thinner there, and all told you can cut the weight of that component by 50 percent. That's wonderful. CAD can help you save fuel or make a plane safer.

Airliners are chock-full of CAD components, so it's seductive to think that solutions presented by software are the only way to go. But here again, plumber-with-wrench insights are crucial. The plane as a whole has evolved out of decades of flight experience that had nothing to do with CAD. What we know about structural weak points, aerodynamics and peak loads on engines came

from thousands of people who contributed over decades to that design with the fear of falling out of the sky forefront in their thoughts. Those people internalized whole sections of the aircraft and understood how all of its various components worked together, and that knowledge has informed modern-day design. Just because we now have CAD doesn't mean all that hands-on experience is moot.

CAD is just another tool, like a pipe wrench. There are things it's good for, and things it's not. The point is that the designer needs to understand the job a pipe wrench is intended to do, in his head, before going to CAD. I think it ought to be obligatory for anyone engineering parts for an airliner to go sky diving at least once before he sits down in front of his computer. I mean, who really understands what a hammer is if he hasn't hit his thumb with one a couple of times?

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the mythbuster

guide to

go



Improbable partners in scientific mayhem: Jamie Hyneman, cerebral engineer, and Adam Savage (opposite), manic artist.

BY LARRY WEBSTER

PHOTOGRAPHS BY JOE PUGLIESE

nzo

engineering

FOR MYTHBUSTERS JAMIE HYNEMAN AND ADAM SAVAGE, DIY ISN'T JUST FOR SHOW—IT'S A WAY OF LIFE.

ON A DEAD-END STREET IN AN INDUSTRIAL corner of east San Francisco stands an unremarkable two-story building. A modest sign identifies the premises as the headquarters of M5 Industries, a special-effects company started in 1994 by Jamie Hyneman—today best known as the star of the Discovery Channel show *MythBusters*—and where his co-star Adam Savage was once also employed. Another, smaller sign politely urges sightseers to go away. There are no tours, autograph signings or opportunities to purchase souvenirs inside.

Except for spooky robots guarding the stairs,

**If you can't
find it, you can't
use it.**
— JAMIE

M5's second-floor offices could be those of any small company, with cluttered desks, a computer room and a small kitchen. Whiteboards are everywhere, crammed with top-of-the-brain doodles, rough technical drawings and the complex logistics of planning the *MythBusters* shooting schedule. In recent years, special-effects work has taken a back seat to the relentless demands of the show, and M5 today functions primarily as home base for the *MythBusters* production team. (The show's secondary segments, involving the team of Kari Byron, Grant Imahara and Tory Belleci, are produced at a different location.)

On this Monday morning, the crew is deep into an episode testing the question of whether golf-ball-like dimples on a car body could reduce aerodynamic drag and improve fuel economy. Compared to crashing two semi trucks head-on (episode 41) or trying to tip over a remote-control city bus (episode 115), today's challenge might seem straightforward. But Jamie and Adam still have to clear some daunting engineering hurdles—while sticking to the show's breakneck production schedule.

MythBusters attracts nearly 2 million viewers per episode, making the six-year-old series one of the most enduring hits on cable television. Its two stars have become global celebrities, much in demand for speaking engagements and conferences. So visitors to the workshop may wonder: Where is the entourage? Where is the army of shop workers to do the grunt work? A handful of production coordinators handle the office telephones, but the usual Hollywood scrum of personal assistants, publicists, cappuccino wranglers and the like is nowhere in evidence.

Jamie, it turns out, is already at work in the machine shop downstairs. I find him at a worktable, using calipers to measure the diameter of a bowling ball. He switches to a golf ball, taking measurements that he transfers to a pad, muttering numbers to himself. He and Adam intend to experiment on a real car, but like all good eggheads, they also want laboratory data. They've booked time at a nearby NASA wind tunnel, where their first test will try to establish just how much those dimples really do reduce aerodynamic drag on a golf ball.

Unfortunately, they've learned that an actual golf ball is too small to produce accurate data. Solution: Jamie has decided to drill dimples into the surface of a bowling ball to create a giant, scaled-up model of a golf ball, one big enough to test in a wind tunnel. Which leads him to the question he is now pondering: Just how deep are those



JAMIE'S ESSENTIALS

MIG Welder

If I could have only one welder, it would be MIG. There are times when you have to use a TIG for high-performance welds and a stick welder for coarse work. But MIG is the easiest, fastest way to weld. And the most versatile—you can use it 90 percent of the time.

Steel Square Tubing

This 1-inch tubing makes for easily welded joints and light, stiff structures.

Dust Collectors

They improve the overall workflow. Dust collectors are the difference between a shop that works powerfully and one that limps along.

Fire Extinguishers

Always have them within easy reach. In our workshop, you're never more than 15 feet away from an extinguisher.

dimples in a golf ball, anyway?

First, Jamie tries to set ball bearings into the golf-ball depressions. When none fit, he switches to washers and discovers that an 8-32 washer is a perfect match. He scales the tiny washer to a larger one and clamps it to the $\frac{5}{8}$ -inch spade bit that he'll use to drill the dimples in the bowling ball. After tracing the new curve onto the bit, he grinds away extra material—a custom tool in 10 minutes.

He hauls out an old bowling ball that the *MythBusters* shot out of a homemade cannon (episode 118). They sanded the ball to fit in the cannon, so it's not smooth enough to repurpose—a favorite *MythBuster* strategy—but it'll do as a test piece. Using a sheet of thin plastic, Jamie makes a template to mark where the dimples should go and tries a few test depressions. Satisfied with the technique, he yells upstairs to see if his lone intern is back with a fresh ball. Nope. Jamie grimaces. He has 5½ hours to finish the build.

Meanwhile, Adam breezes into the wood shop and sets a plastic remote-control model car down on a workbench; trailing behind is Huxley, Adam's medium-size mutt. Since the NASA wind tunnel is too small to accommodate a full-size car, Adam is going to use the toy to make a mold for two model

Some 600 boxes lining the shelves at Jamie's M5 workshop reflect the eclectic nature of mythbusting and the special-effects business for movies and commercials.



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SURFACE
GAUGES

Lubricant
Misc. Oils

Wheels
(rollers)

Food
Fake
Fish

PUPPET
HEADS

RUBBER
BANDS

Jamie built these robots—just some of the mechanical wonders at M5—for a GE commercial.



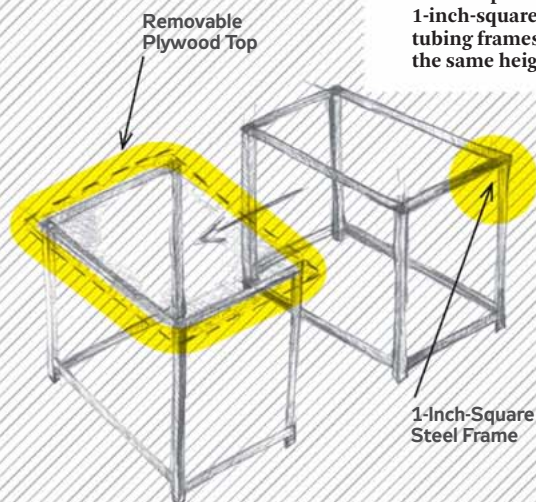
JAMIE'S NESTING TABLES

I designed and built these tables to save floor space and increase countertop area in our workshop. The two 1-inch-square steel tubing frames are the same height, but

the four-sided inner frame is narrower, so it fits inside the three-sided outer frame. Both tabletops are plywood. The inner top isn't

secured to its frame; when the frames nest, it rests on the outer table's top, temporarily secured with wood screws. When expanded, most nesting tables have stepped-down

surfaces. With my design, when I slide out the inner table and move its top into place, it's flush with the outer top, doubling the work-surface area.



cars—one with dimples, one without. He moves to a table saw and cuts a piece of Trupan, a lightweight fiberboard that he'll use to fill some of the mold's casting volume. Huxley doesn't bark or bolt at the sound of the saw—a real MythBuster dog. In less time than it takes to read this sentence, Adam test-fits the workpiece in the model and adjusts the saw fence three times. He cuts the rest of the pieces so quickly that it seems remarkable he has all his fingers.

On TV, Jamie, 52, comes across as the cerebral engineer, while Adam, 42, plays the role of the manic artist. In person, that distinction is even more pronounced. Adam races into every task, often working by eye and tweaking the design as he goes. And no build is considered finished until he has added some trademark visual flourish. His internal throttle is always on full. "There's nobody faster than Adam," says Alice Dallow, the director of the show's Jamie and Adam segments. "He figures it out on the fly."

THE SOUTH HALF OF THE GROUND FLOOR OF M5 IS A wide-open space filled with obscure fasteners, actuators, batteries, welders, stacks of plywood—all the tools you can imagine, even an automated CNC milling machine. It's a serious bit of kit, a dream shop for any backyard tinkerer.

The space is meticulously laid out and organized. Everything is labeled. Most tools rest on open shelves for quick retrieval. It's neat, almost surgically antiseptic. Jamie talks

about the place as though it's a church, which probably resonates with anyone who has a favorite shop. "It's a living, breathing organism," he says. "Its character has been formed by the experiences inside."

The south wall is dramatically defined by metal shelves that rise to the 20-foot ceiling. On those shelves are 600 labeled crates—Foliage, Suits and Booties, Tank Parts. One container, way up high, is labeled Blendo. Tucked inside is the killer robot that started it all.

When Adam worked for M5, he and Jamie collaborated on the mischievously named Blendo and entered it twice in an annual San Francisco event called Robot Wars. The now-defunct competition featured robots dueling to the death, the nerd version of a steel-cage match. Blendo's outer skin is an inverted wok; two opposing blades jut menacingly from the base. The bot spins as it moves; in the ring, it shredded opposing machines, flinging shrapnel into the crowd. Both years, after Blendo won its first two matches, organizers awarded it the heavyweight prize—and then prohibited it from completing the competition because of concerns about safety. But in 2002 when Discovery Channel producers were casting a new show called *MythBusters*, somebody remembered Blendo. Jamie got a call. "I figured the odds of the show turning into anything were lower than the odds of getting hit by lightning," he says. "So, excited? Well, no, not really. I rarely get excited."

In retrospect, Jamie's first choice for a co-host—Adam—seems surprising. After all, Adam had lasted only a few years at M5. As much as Adam's speed was a huge asset in the notoriously fast-paced special-effects industry, the two men sometimes butted heads over the mess the Adam whirlwind leaves behind.

While they're not best friends—"We don't hang out," Jamie says—they have learned to appreciate each other. "There's nobody that either of us would rather work with," he continues, "because we know we're both capable in our own style." Adam adds: "We can drive each other nuts, but there's a commonality between us that makes collaborating such a pleasure. We both work very hard to get a concept into our heads, and then we work very hard to trade back and forth what we're thinking through a process called arguing."

"That back and forth is comparable to a couple of dogs that have gotten hold of a towel and then start yanking on it,"

**For the tools
you use often, get
the good stuff.**

— ADAM

**Sometimes I buy
cheap tools and
modify them.**

— JAMIE

Jamie says. “The process shakes out a lot of things we would otherwise miss, and by the time we’re done arguing and battling things back and forth, we’ve got the solution.”

Jamie is extremely methodical, a classic engineer type, taking in information, turning it over in his mind and then outputting a response. “He thinks everything through before he starts,” Dallow says. “And his build will be as simple as you can possibly imagine. He’s not interested in fancy color schemes.”

Jamie is the Spock of the team; logic trumps all with him. He shows little emotion—unlike Adam, who sometimes wears a T-shirt that reads, “I’m the excitable one.” It’s not that Jamie lacks passion; he’s just deadpan about it. A discussion about a favorite project—say, the life-size robots parked under the stairs—can turn into an entertaining and instructive lecture. He built the wheeled bots, which look straight out of a 1950s sci-fi movie, in just three weeks for a GE commercial. Their signature feature is what Jamie calls a superjoint, which simulates an elbow joint. (He’s applied for a patent on the design.) With two cordless electric-drill motors (“one of my favorite powerplants”) mounted in line with the upper arm and hooked to the side gears of a differential gearbox, he designed an arm that functions like the real thing. Spin both motors in the same direction to raise the forearm; reverse one motor to rotate the hand. “It’s twice the power for any movement without adding any weight,” he says.

Jamie finds inspiration at swap meets and hardware stores, keeping a “rolling inventory” of material that may prove useful. To solve particularly tough problems, however, he goes into Jamie-land—a metaphorical room of a certain size and shape. “I get on a treadmill and start walking,” he says. “It’s like hitting a switch. Once I’m in that room, I re-create the parts I’m working on. I pull in one part after another and move them around, trying things. An hour later, it’s like I don’t know what happened. I just wake up, soaking wet from the exertion. The problem was solved but I was totally unaware of time passing.”

He grew up in Indiana, studied Russian linguistics at Indiana University (“it was interesting at the time”), owned a Caribbean dive shop and worked as a boat captain. Although landing in the special-effects industry might seem like the hand of fate, it was planned. “I went to the library

and researched different industries,” he says. “The effects industry seemed to be the perfect place for my natural mechanical aptitude and the skills I’d picked up along the way. Plus, it was possible to earn a living doing something fun. Everyone should do what they find fun, because if you do, your passion leads to success.”

ADAM’S HOME WORKSHOP REFLECTS THE INSPIRATION

he finds in “a certain amount of visual cacophony.” With limited space at his urban address, he jams an alarming number of tools and old props into a 10 x 12 room off an underground, single-car garage. In the suburbs the space would be a good-size walk-in closet.

At first glance the workshop looks like the lair of a classic pack rat, but closer inspection reveals an order to the madness. Below a workbench are 22 Sortimo organizers filled with “all the fasteners I’ll need forever.” Shelves cover every wall and even the lone window. Spools of wire hang behind the door. “I hate looking for things,” he says. “A good shop has to have first-order retrievability, so I don’t have to move anything to get to what I need.”

The shelves hold an eclectic mix of artifacts, like a vintage stopwatch and a medieval armored glove, as well as some unfinished projects. In his limited spare time, Adam painstakingly re-creates movie props. He built a working R2-D2 and a copy of the Maltese Falcon. He’s currently reproducing the Zorg ZF-1 egg gun from the movie *The Fifth Element* and is relishing the art of gunsmithing. (“I’m almost done with it,” he says. “I’ve been working on it for, like, 12 years.”) His off-hours work seems to favor his artistic side, like the King Kong statue he’s painting, but he thinks it’s wrong to separate art from engineering. “Someone who designs a really

ADAM'S ESSENTIALS

Portable Band Saw
It's quiet and cuts through steel, aluminum, wood and plastic. I could cook with the thing, I love it so much.

Trupan
I build everything out of 1-inch Trupan. It's half the weight of typical particleboard and doesn't have any formaldehyde in it.

Leatherman
One of the best tools ever invented. I've got about eight—one for every toolbox.

LED Flashlight
It's insanely useful to have one with you at all times. Once you start, you won't be able to do without it. Promise.

Sortimo System

I bought a bunch of suitcase-size tool sorters and filled them with every nut and bolt I'll ever need. The cases slide under my workbench, and they're labeled on the side so I can find everything. And I can fit the cases in the back of my truck.



Adam's home workshop is just 120 square feet, so Sortimo cases are key in optimizing the limited storage space.

good carburetor is going through the same process as a painter," he says.

Growing up outside New York City, Adam had free rein with his father's hardware-store charge account. He worked alongside machinists and welders, picking up skills on the job. He studied drama at New York University, worked with robotic sculptor Chico MacMurtrie and finally landed in San Francisco's special-effects community. His reputation for quick problem-solving and construction—"I like screwing it up twice and still doing it better than the guy who did it once"—led to the gig building props for Jamie at M5. After M5, Adam worked at a toy company and then joined Indus-

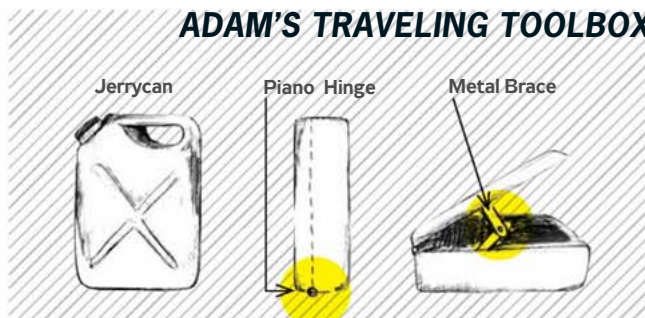
trial Light & Magic, the special-effects outfit founded by George Lucas. Then came Jamie's call to join *MythBusters*.

Back at the worktable, with a cameraman filming over his shoulder, Adam coats the inside of the mold with wax and then with a layer of mold-release spray. The delicate model-car mold is the only one available; if Adam damages it, the shoot is over. So he very carefully ensures that every corner is covered. The two-part polyurethane resin generates heat as it reacts, which could distort the mold. He has to make two models with it, so he pours in a small amount of the resin to form an insulating layer. After a few minutes, he puts on a breathing filter and mixes the resin with glass microballoons, a filler



Adam shows his model-making artistry with recreations of classic movie props, like King Kong and the Maltese Falcon. "It's what I do to relax," he says.

ADAM'S TRAVELING TOOLBOX



Every off-roader needs a toolkit, but space inside my 1982 diesel Toyota Land Cruiser is tight—and a tailgate-mounted toolbox might attract thieves. So I converted a metal jerrycan commonly

found on adventure rigs into an incognito toolbox. On the narrow side, opposite the gas cap, a piano hinge riveted in place connects the halves of the can; a two-piece metal brace holds the top

part open. Aluminum sheets divide the interior space and secure smaller items. To further conceal the can's true purpose, I made a tailgate mount with steel supports that hide the seam.

material. He pours in the mixture, sets in the Trupan blocks and puts the mold aside. Cut!

AS FUN AS IT IS TO WATCH

Jamie and Adam produce mechanical oddities, it's interesting to see how the MythBuster team has reinforced the value of science, engineering and the art of building things. In recent years science and math education in American schools has suffered as shifting priorities have reduced opportunities for students to perform hands-on experimentation.

By investigating urban legends and half-baked engineering "truths"—proving some, debunking others—Jamie and Adam have played an important role in changing attitudes about science. The show's genius is that beneath the kinetics and risky stunts—spectacular car crashes, explosions and other dangerous merriment—is a cleverly veiled science show that instructs as it entertains, which any teacher will tell you is a real feat. "I like to think," Jamie says, "that there's a whole do-it-yourself sort of mentality that is growing."

If the decades ahead produce another Thomas Edison or Steve Jobs, odds are that he or she will have grown up watching *MythBusters*. The workshop's office is covered with drawings made and sent by children. "We've shown that it's a lot easier to get hands-on experience than people think," Jamie says. "You can memorize how to do something, but unless you internalize the information, it's just a pile of data sitting on a table. Hands-on experience is what allows you to make it part of your brain; it brings that data to life."

It's 3:30 pm—just 2 hours from the deadline for wrapping up the day's shoot. Adam's mutt Huxley naps, while his equally relaxed owner adjusts the chuck of a lathe in the machine shop. His next task—drilling dimples into one of

the cast car models. He's making a sleeve that he hopes will fit over a drill bit and quickly produce the right dimples. "I very much enjoy cutting a couple of thousandths off a piece."

The intern has delivered a new bowling ball, so now Jamie is back at the drill press, dimpling the 10-pounder. It takes almost an hour of drilling the holes to just the right depth and repositioning the ball, a sequence Jamie performs 321 times without stopping. While it sounds like assembly-line drudgery, Jamie doesn't mind. "I enjoy the opportunity to turn off my mind," he says. In fact, I hear him humming. Could it be "Zip-A-Dee-Doo-Dah"?

Meanwhile, Adam finishes the drill-bit sleeve and sets to work on the 24-inch-long car casting. He drills a couple of dimples, but the results are not quite right. He tries a few without the sleeve and learns that he can get the desired result without the piece he's spent half an hour crafting. "Sometimes you go down a path, and it's not the right one," he says. "So you have to start all over again. It's like throwing money into a bad poker hand. You have to know when to stop." Adam's demeanor wouldn't suggest he has the patience for this repetitive work, yet he plows right through it. "It's like cleaning up a room," he says. "You pick up one thing at a time." In 45 minutes, he drills 732 dimples.

Now it's 4:30. The only thing left to do is the painting. Jamie sets his ball under the painting booth and goes to work with a spray can, moving slowly, precisely. Adam takes his turn, moving his spraying arm quickly back and forth past one of the model cars. "The trick is to spray past the object you're painting," he says. "See? It's easy." His hand is a blur. **PM**



ON THE WEB > Take a guided video tour of the *MythBusters* workshop at popularmechanics.com/mythbustertour.

There's no shame in starting something but failing to finish.

—ADAM



classic diy

TO BUILD A BOAT

* by ROY BERENDSOHN

BEFORE THE SPACESHIP OR THE CAR
OR THE COVERED WAGON, EXPLORERS CRAFTED SEAGOING VESSELS. WE FELT
ADVENTUROUS. SO, USING OLD PLANS, HAND TOOLS AND A CRAMPED
GARAGE AS A SHOP, WE GOT TO WORK.

: photographs by BRAD PARIS



• ***It was a long time since anyone in my family had built a boat.*** The last was my Uncle Paul. He was a shipbuilder who learned his trade beginning at age 14 in Hamburg, Germany. Every morning, the boy rowed from the family's dock out across the shipping lanes of the Elbe River, which flows into the North Sea. The trip to the shipyard where he was apprenticed took an hour and a half, longer in winter, when there was fog and floating ice on the water. After three years, Paul received a journeyman's certificate and a berth aboard a gigantic four-masted windjammer named *Passat*—

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SEPTEMBER
2009
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“trade wind” in English. That was in the 1920s, before the fascists confiscated his family’s own small shipyard and the Berendsohns left for America.

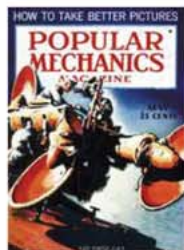
A few months ago, I decided to try my hand at the ancestral trade. I’ve built everything from houses to a blacksmith’s forge (March 2009), but there’s no more evocative project than a boat, at least to me. Since before Austro-nesians first gazed across the Pacific, wooden vessels have stood for craftsmanship and the drive to explore. I sifted through PM’s archives looking for a classic design and eventually settled on a 10-foot dinghy from our May 1937 issue. It looked elegant, yet simple enough to build on a pair of sawhorses.

It’s been many years since my Uncle Paul was around to lend advice, so I ran the drawings past Timo White, a boatbuilder at Tuckerton Seaport, a small maritime museum on the New Jersey coast. It turned out that Timo was in the midst of restoring a surfboard built from plans in the July 1937 issue of PM. (It was a big year for seafaring projects, I guess.) He confirmed that the dinghy was a good candidate for a first-time builder and agreed to lend a hand if needed.

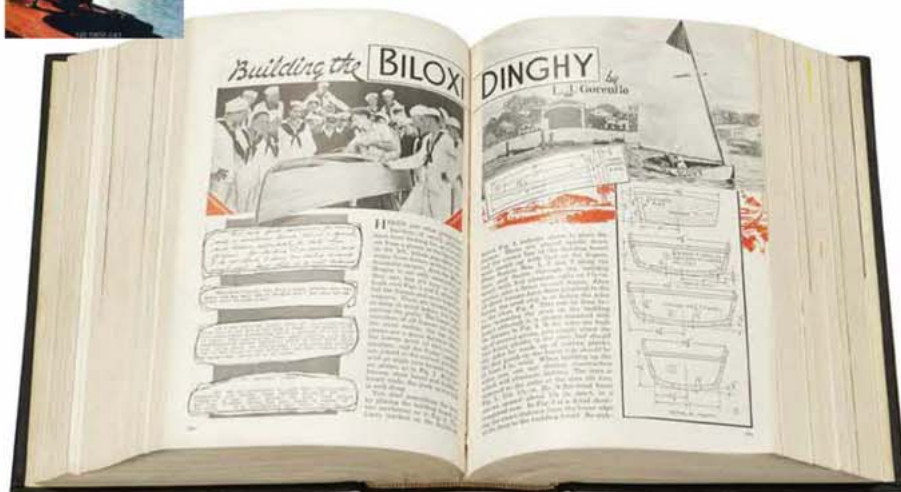
SHIPYARD IN THE DRIVEWAY

• **On a wintry early spring** morning I set out for Willard Brothers Woodcutters, a sawmill and lumber dealer in Trenton, N.J. You can spend hours there, roaming stacks of delicious-looking walnut, cherry and oak, some of the boards as wide as your arm is long. I bought red oak for the *Sea Scout*’s

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These plans for a small and simple sailing boat design called a Biloxi Dinghy appeared in POPULAR MECHANICS in May 1937. To simplify the project, I omitted the mast and centerboard. Instead, I built the Sea Scout, named after the craft in the original article, to be rowed or powered by an outboard motor. She works well in either configuration.



MAY
1937



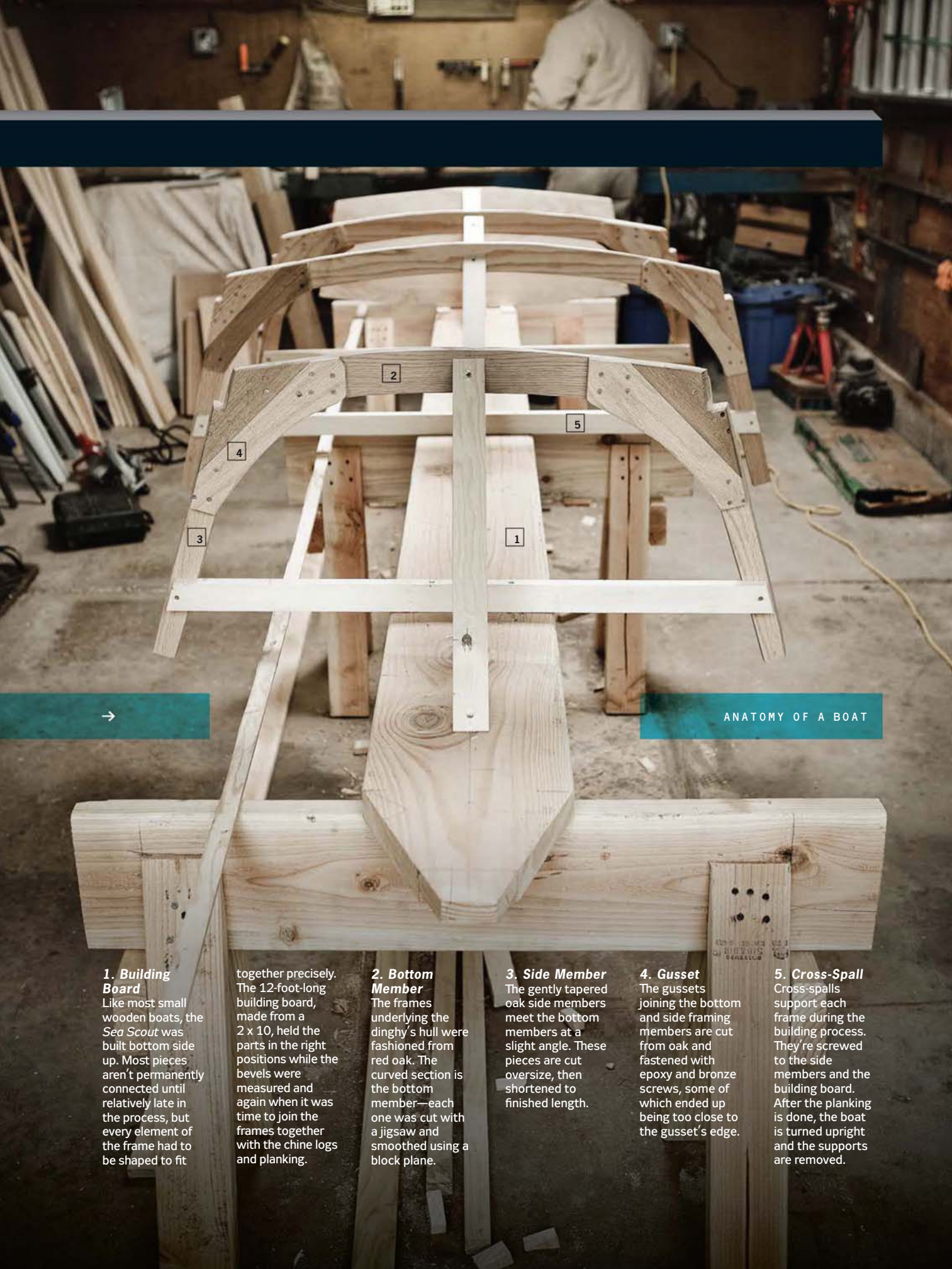
frames (that was the name of the craft in the plans, and I chose to keep it) and a 2-inch-thick slab of white oak for the wedge-shaped stem at the bow.

Back home, I started making a racket feeding planks through a table saw. My skills were creaky—I’ve spent too much time in recent years fixing stuff and not enough building—but over a few days my old confidence returned. The *Sea Scout* began to take form.

Most boats begin with the frames, the ribs that provide structure to the hull. I roughed them into shape, along with the stem and the gracefully shaped stern wall, or transom, which I cut from $\frac{3}{4}$ -inch plywood. Then I braced it all to a building board—which is nothing more than a 2 x 10 with a chalk line marked down the center. The boat’s skeleton was in place, but each member still needed to be precisely beveled

before I could secure the curved planks of the hull. The next step was to clamp thin strips of wood, called battens, to the frame to stand in for the planks, so I could measure and mark all those angles. Then, I took the parts off the board and finished shaping them.

Often, the weather confined me to the garage, but when the sun emerged I worked in the driveway. If you want to get to know the neighbors, start building a boat. Linda from next door asked whether the craft would be sailed, rowed or powered by an outboard motor. Others wondered where I would go with it, how I’d get it there and what I would name it. A truck driver from Tulnoy Lumber, dropping off some marine plywood, approached respectfully. “This is beautiful,” he said, with an old-fashioned New York accent as broad as the hand he ran over the frames.



ANATOMY OF A BOAT

1. Building Board

Like most small wooden boats, the *Sea Scout* was built bottom side up. Most pieces aren't permanently connected until relatively late in the process, but every element of the frame had to be shaped to fit

together precisely. The 12-foot-long building board, made from a 2 x 10, held the parts in the right positions while the bevels were measured and again when it was time to join the frames together with the chine logs and planking.

2. Bottom Member

The frames underlying the dinghy's hull were fashioned from red oak. The curved section is the bottom member—each one was cut with a jigsaw and smoothed using a block plane.

3. Side Member

The gently tapered oak side members meet the bottom members at a slight angle. These pieces are cut oversize, then shortened to finished length.

4. Gusset

The gussets joining the bottom and side framing members are cut from oak and fastened with epoxy and bronze screws, some of which ended up being too close to the gusset's edge.

5. Cross-Spall

Cross-spalls support each frame during the building process. They're screwed to the side members and the building board. After the planking is done, the boat is turned upright and the supports are removed.

WORKING THE PLANK

• **I don't know** how Uncle Paul felt about it, but boatbuilding can be acutely frustrating. The bane of my weekends proved to be a small bronze screw. A No. 6 Frearson flat-head, to be exact. Like most modern DIYers, I'd been spoiled by drywall screws and other aggressive fasteners that practically plow into the lumber. Even using a specialized, tapered drill bit and a waxlike lubricant with the unlikely name of Akempucky, I managed to wreck screws by the dozen. The head on one would strip a moment before the screw was fully seated, while another would shear off on the last eighth of a turn, leaving me with a shiny Frearson-head penny.

Timo had tried to downplay the arcana I'd face—"It's more like house carpentry than fine-furniture building," he had said—but I still found myself floundering on occasion. One challenge was that the 1937 article was more an overview than a detailed set of plans. And, though it pains me to find fault with my forebears at *POPULAR MECHANICS*, the sketch contained suspicious discrepancies. Timo helped me recalibrate some of the dimensions midway through the project—and I had to trim several pieces after they were assembled.

The biggest hurdle came when it was time to plank the hull. The classic way is to bend strips of solid wood to the frames. I'd chosen marine-grade fir plywood instead to save time, but now I was barely able to force the hull's $\frac{1}{4}$ -inch sheets into place. There was no way the half-inch plywood I'd planned for the bottom was going to work.

Timo advised me to switch to a special, wafer-thin marine-grade plywood and plank the bottom in two layers. He came swooping in one Thursday morning to show me the technique. He stepped out of his truck with a broad



1

TIMO PRODUCED A CAN OF AMSTEL LIGHT IN LIEU OF CHAMPAGNE. I POPPED IT OPEN AND EMPTIED THE BEER OVER THE PAINT. "I CHRISTEN THEE SEA SCOUT," I SAID.

smile, and a block plane in each hand, and my mood lifted. He politely took a sighting down the chine logs where we'd attach the bottom, and spent a few minutes planing them to the last measure of precision. Then we got to work with staples, glue and screws—and in a couple of hours the project went from a plywood flower bed to a small craft with sensuous compound curves.

It was satisfying, but my mistakes still showed in details like the placement of screws and the shape of the stem. "You know what they say," Timo told me. "Putty and paint makes a boat what it ain't." I got out my paintbrushes.



3



↓

1. Very few elements in a boat are simply cut to shape and installed. Like the oak stem shown here, nearly every piece needs to be beveled or curved to fit the surface it meets. (That tool is a fore plane I own, built by Stanley Tools in 1927.)

2. Ancient terms persist in boatbuilding. This curving wood piece, where the bottom is attached, is called a chine log. In past centuries, it consisted of a single log chosen for its natural curve, then shaped to fit. The chine log is set in a notch and fastened to each frame.

3. Two layers of okoume plywood form the bottom of the Sea Scout. Timo (foreground) showed me how to install them.

4. The Sea Scout motored along nicely, powered by this 2.5-hp four-stroke Mercury Marine outboard.



MAIDEN VOYAGE

• **We launched the boat** at Tuckerton Seaport on a cool, overcast day that felt more like September than June. Down at the dock, Timo produced a can of Amstel Light in lieu of champagne. “Go ahead,” he said, “pour it over the bow.” I popped it open and emptied the beer over the paint. “I christen thee *Sea Scout*,” I said. Then we slid the little craft off the dock and into the water.

You might think a feeling of triumph came over me. Not so. The *Sea Scout* looked very small, almost helpless, as she sat bobbing at the end of the painter, the little rope that Timo had threaded across the bow. I felt humbled. A phrase from the Book of Psalms flashed in my mind: “They that go down to the sea in ships, that do business on great waters.”

I wasn’t aiming for any great waters myself. I eased off the dock and into the boat. Timo handed me the oars. Awkwardly, I drew the handles back, just above my hips. The craft slid forward gracefully, almost like she was on ice. As Timo watched, I braced the left oar down in the water and swept the surface with the right. The *Sea Scout* pivoted neatly, unexpectedly elegant and spry.

If the oars were a kick, you can imagine the thrill I felt when I mounted the 2.5-hp Mercury Marine outboard on the transom. It’s a clean-running four-stroke engine, compact yet almost zippy on a boat this small. I gave the engine full throttle and cut some nice straight lines and a pleasingly tight curve complete with a crisp little wake.

With the afternoon gone, my first voyage was complete. In the end, I decided to donate the boat and engine to Tuckerton Seaport. Frankly, I needed the space in my garage and driveway: The *Sea Scout* was a good first foray into wooden boatbuilding, but I knew I could do better—and I’m already sifting through plans.

PM

the rocket rocn men

How an improbable partnership between an Internet mogul and an engineer could revolutionize the way NASA conducts missions—and, if these iconoclasts are successful, send paying customers into space.

by michael belfiore
photographs by gregg segal

In late 2001, Tom Mueller was sacrificing his nights and weekends to build a liquid-fuel rocket engine in his garage. Mueller, a propulsion engineer at Redondo Beach, Calif.-based aerospace firm TRW, felt like an “unwanted necessity” at his day job. His prolific ideas about engine design were lost at such a large, diverse company. To satisfy his creative impulses, he built his own engines, attached them to airframes and launched them in the Mojave Desert with fellow enthusiasts in the Reaction Research Society, America’s oldest amateur rocketry club. RRS





SpaceX propulsion chief Tom Mueller (opposite) examines a spacecraft control thruster. Mueller's Merlin engines (above, in Hawthorne, Calif.) power rockets that NASA needs to haul cargo to the space station. SpaceX founder Elon Musk has an even bolder objective: manned flight.

members, many of them employees at aerospace firms, meet regularly in the Los Angeles area to build and launch the biggest and highest flying rockets they can—just as the group has done since it was founded in the early 1940s.

Building a liquid-fuel rocket engine isn't easy, even for an experienced propulsion engineer. Liquid propellants are cheap and provide lots of lifting power, but the engines rely on a host of valves and seals to control the flow. And they usually require supercooled oxidizers, like liquid oxygen, to mix with the fuel so it can ignite. The resulting combustion—essentially a controlled explosion—is channeled at high pressure into the nozzle, creating the thrust that propels the rocket. Despite these challenges, by early 2002 Mueller had moved his operations to a friend's rented warehouse and was putting the finishing touches on the world's largest amateur liquid-fuel rocket engine, an 80-pounder designed to produce 13,000 pounds of thrust.

Mueller's ambitious moonlighting caught the attention of Internet multimillionaire Elon Musk, who met the engineer at the warehouse in January 2002 as Mueller was trying to attach his homemade engine to an airframe. Fresh from the \$1.5 billion sale of PayPal to eBay, Musk was seeking staff for a new space company, soon to be called Space Exploration Technologies, or SpaceX. He eyed the rocket engine and asked a simple question: "Can you build something bigger?"

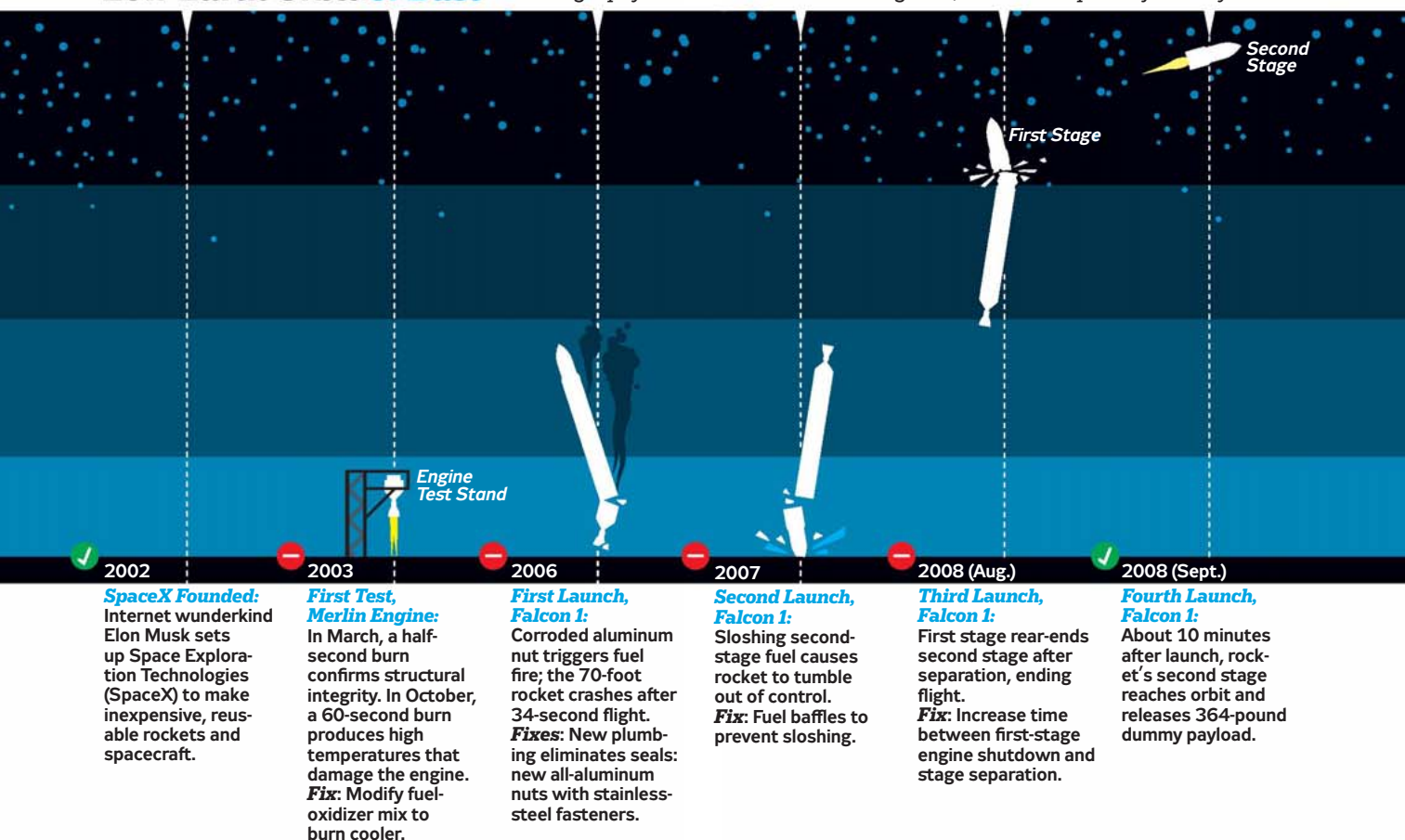
Mueller never fired that engine. He took it back to his garage, where it still sits. Instead, he took up Musk's offer to join the nascent private space venture. Today SpaceX has more than 700 employees, 500 of them at corporate headquarters in Hawthorne, Calif. Mueller is vice president of propulsion. "TRW is a huge company with a tiny propulsion department," Mueller says. "Here, I'm kind of king."

On the floor of the Hawthorne facility, a former Boeing 747 assembly plant, rests the engine assembly from SpaceX's Falcon 9 rocket. Soot from a test firing coats the 12-foot-high structure. Seven of nine engines are in place; technicians have removed the other two and stood them upright on nozzles nearly 3 feet wide. Topped with a 3200-hp turbopump and a tangle of plumbing, each engine stands taller than a man.

Once all nine engines have been refurbished, the assembly will be shipped to the company's test center in McGregor, Texas. Firing one engine to simulate a run to orbit awakens babies in towns miles away. The full cluster, which produces nearly 1 million pounds of thrust, must

Low Earth Orbit or Bust

Putting a payload into orbit is a daunting task, but it took SpaceX just six years to



Elon Musk combined his passion for spaceflight with business savvy to position SpaceX at the head of the pack of companies trying to launch private rockets into orbit.

have them bouncing in their cribs like jumping beans.

Last year, NASA awarded SpaceX a \$1.6 billion contract to send cargo to the space station; it also issued a \$1.9 billion contract to another company, Orbital Sciences. This marks the first time NASA has included private launch vehicles in its plans. "NASA is counting on them," says William Gerstenmaier, the agency's associate administrator responsible for space operations.

Early next year a SpaceX rocket will approach the station in a test flight, with another test to follow in rehearsal for an unmanned docking by the end of 2010. "I never thought that I'd be doing a big program for NASA," Musk says. "It's kind of wild. Launching from Cape Canaveral is like opening on Broadway."

Before Musk made his millions, he identified three main areas that he thought could provide maximum benefit to humanity: the Internet,

transform early failures into a successful launch.



renewable energy and space exploration. After the windfall sale of PayPal, he scratched the Internet off his list. Within a year of the sale, Musk invested in a pair of companies, electric-car developer Tesla Motors and the solar-power outfit SolarCity, to help foster alternative-energy research. That left space exploration—"in particular the extension of life beyond Earth," he says—as the last item on the list.

Musk wanted to finance a Mars lander, but he discovered it would cost more to launch the craft than to build it. He decided that what the world really needed was affordable rockets. So he searched the ranks of the RRS for engineers who could achieve results on a budget and found a strong candidate for propulsion chief in Mueller. "Tom had an awesome track record of engine develop-

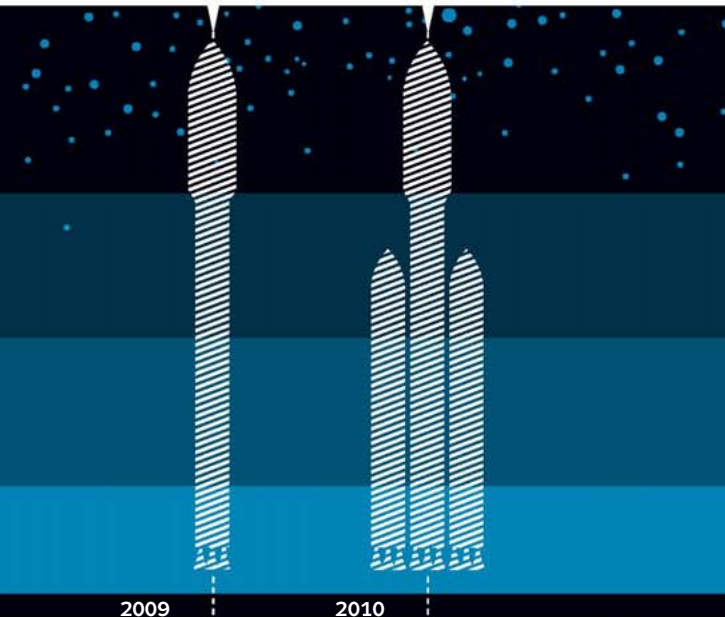
ment at TRW," Musk says. "I also really liked the fact that he built and tested rocket hardware with his own hands."

With the resources of SpaceX, Mueller was able to produce a reliable engine with a simple design at a cut-rate price—the Merlin. It was the nation's first new large liquid-fuel rocket engine to fly in 40 years. The Merlin runs on highly refined kerosene and cryogenically cooled liquid oxygen, and uses a single injector, unlike more complicated engines that mix fuel and oxidizers at multiple points. But, even with modern technology, rocket engines are notoriously unpredictable.

To prevent heat damage, Mueller treated the nozzles of the early versions of the Merlin with resin impregnated with silicon fibers. This ablative coating chars and flakes off as the engine runs, taking damaging heat with it. The goal was to have an engine that could withstand a punishing 160-second burn—long enough for the first stage of SpaceX's Falcon 1 rocket to reach an altitude of 56 miles, where the second stage's smaller engine kicks in to boost the cargo to 81 miles and low Earth orbit.

In October 2003 Mueller and his engineers sat in the SpaceX control bunker in Texas and fired up a Merlin on the test stand. During the 60-second run, the exhaust began to melt the metal in the engine's throat. The heat also endangered seals that governed the flow of the propellant. If the engine had run any longer, it would have blown up.

It took months to work out the bugs. Mueller's team reduced the amount of liquid oxygen entering the injector to make the engine run cooler and less powerfully, and strengthened the seals. Fifteen months after that first test, the engineers invited me to join them in the bunker as they attempted to run the engine for a full mission duty cycle—the time needed to send a payload into orbit. After a tense countdown, the engineers watched on wide-screen TV monitors as the engine coughed and then blazed to life. A caged-beast roar penetrated the concrete and packed earth walls of the bunker; the steel grates of the test stand's floor shivered and rattled, finally shaking loose a panel that danced across



2009

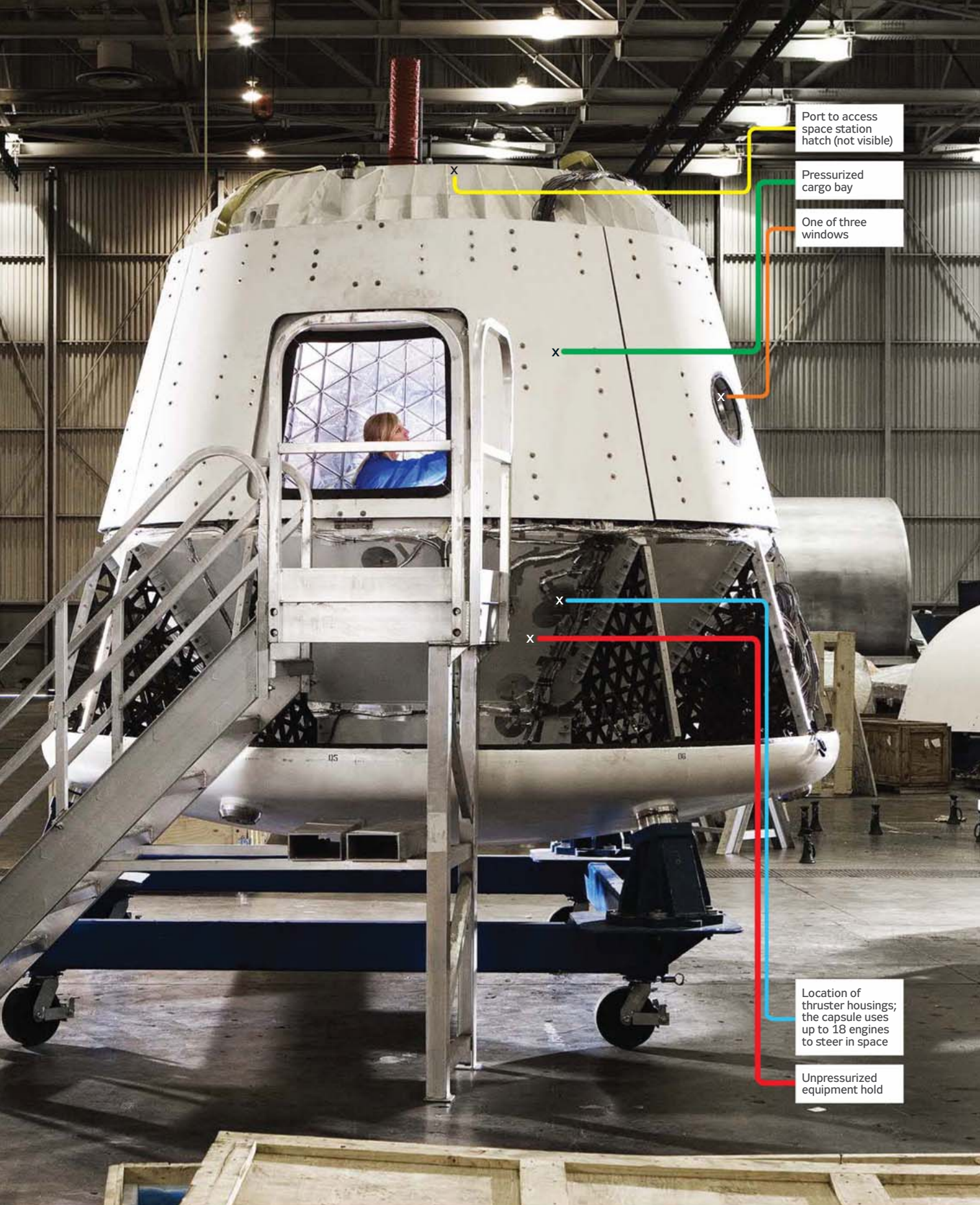
First Launch, Falcon 9:

A successful launch in late autumn means the 180-foot-tall rocket may be able to send a capsule to the International Space Station next year.

2010

First Launch, Falcon 9 Heavy:

Designed to boost 65,280 pounds to low Earth orbit.



Port to access space station hatch (not visible)

Pressurized cargo bay

One of three windows

Location of thruster housings; the capsule uses up to 18 engines to steer in space

Unpressurized equipment hold

Engineers at SpaceX's California facility assemble a Dragon spacecraft designed to carry cargo to the space station. Windows reveal the company's long-term goal to use the capsule for manned flights.

What goes up: Mueller (in helmet) and other amateur rocketeers locate the landing site of a solid-fuel booster launched in the Black Rock Desert in 1996.

our field of view. The engine ran flawlessly, shutting down after 162.2 seconds when its fuel tank ran dry. After the sudden silence, the room erupted in cheers. “Call Elon!” Mueller yelled. “Tell him we just ran a full duration!”

Building a reliable engine was only the start of the engineering challenges. In 2006, technicians mounted the Merlin engine on SpaceX’s 70-foot-tall Falcon 1 rocket and launched it from the company’s facility at Kwajalein Atoll, 2500 miles southwest of Hawaii. The liftoff looked perfect, but the rocket was doomed before ignition.

During weeks of preflight tests, salty Pacific air had corroded an aluminum nut in the engine. Just before liftoff, when the propellant valves opened, the nut failed and caused a leak. When the engines ignited 2 seconds before liftoff, the spilled fuel caught fire. Thirty-four seconds after the Falcon launched, flames burned through a pneumatic line and shut down the engine. The rocket crashed into the Pacific a few seconds later.

It was the first in a series of failed launches. A year later, sloshing fuel in the second stage of another Falcon 1 caused oscillations, and the rocket spun out of control before reaching orbit. During the third flight in August 2008, the first stage collided with the second stage just after separation. Both fell into the ocean. An investigation showed that engine improvements had increased residual thrust, leading to the impact.

Less than two months later, those expensive and embarrassing failures were forgotten. At SpaceX’s Hawthorne headquarters, Mueller, Musk and the staff watched a video feed from Kwajalein as another Falcon I roared from its South Pacific launchpad. Images from cameras mounted on the rocket showed the first stage falling back to Earth and the second-stage engine kicking on, boosting the rocket into space.

The fairings at the tip of the Falcon separated and fell away; they would eventually incinerate while re-entering the atmosphere. Less than 10 minutes after liftoff, at 16,400 mph and 81 miles—fast enough and high enough to remain in orbit—the Falcon released a dummy payload. Musk and Mueller had created the first private liquid-fuel rocket to reach orbit.

Soon after that successful launch, customers began signing up for future flights on the larger,



far more powerful Falcon 9. The rocket’s nine engines give it an important asset: reliability. It is the first since the Saturn series from the Apollo program to incorporate engine-out capability—that is, one or more engines can fail and the rocket will still make it to orbit.

According to its launch manifest, the company will boost the payload of the first customer, U.K.-based Avanti Communications, by the end of this year on a Falcon 9. Four other outfits have placed orders through 2015. SpaceX’s fees for launching payloads on a

Falcon 1 start at around \$8 million, a bargain compared to the estimated \$13.5 million charged by competitors. A 2009 Government Accountability Office report confirms that the company manufactures almost all of its own rocket components, avoiding dependency on costly external suppliers. “SpaceX has a great deal of in-house technical skill,” says Alan Lindenmoyer, NASA’s commercial crew and cargo program manager. “But they also have the entrepreneurial spirit that drives them to succeed.”

Elon Musk’s spaceship, the Dragon, sits on the shop floor in Hawthorne; technicians are preparing the full-size capsule for vibration tests by installing weights to stand in for uncompleted avionics and other gear that will be stored in the unpressurized equipment hold in the Dragon’s base. A hatch opens to a second hold pressurized for cargo that cannot survive the vacuum of space. Staff have painted an indigo dragon on the hull, wings outstretched. The image evokes the twin solar panels that will open from the capsule to provide power during extended missions, such as those for microgravity experiments.

Despite the pressure of the NASA contract and the demands of SpaceX’s other clients, Musk is still chasing his dream of sending people beyond Earth. NASA has not yet asked the company to build any hardware to carry astronauts to the space station, but SpaceX engineers are preparing the Dragon capsule to handle a crew of seven. Every Dragon spacecraft, even ones that will only carry cargo, has windows. I climb a short metal ladder to the pressurized hold; it’s roomy, with curving walls that are too far apart to reach with outstretched arms.

NASA says its new reliance on private companies to ferry cargo to the space station will free the agency to focus on manned flights to the moon and, eventually, Mars. But, as the windows on the Dragon indicate, SpaceX has plans that go far beyond handling NASA’s freight. Who knows—at the rate Musk, Mueller and company are going, SpaceX just might reach Mars first. **PM**



PM TEST DRIVEN

Dual to the Death

FIVE GUYS, FIVE NEW DUAL-SPORT BIKES AND



→ **Watch out for the decreasing-radius hairpin turns when** you're blasting down Death Valley's Titus Canyon. I'm the lead rider in our group of five, my helmet and hands buzzing from the KTM's torquey 449-cc four-stroke. Every twist of this serpentine, dusty trail hides a surprise, and any hamfisted moves with the throttle could mean a side trip into the unforgiving brush—perhaps worse. Suddenly, the trail snakes abruptly to the right; I barely make the turn and drift wide into the soft, sandy shoulder as the prickly branches of the desert sagebrush graze my pant legs. Whew.

Death Valley is notoriously unforgiving. It's remote, dry and, yes, very hot—134 F is the record temperature. There's good reason auto engineers arrive here every summer for hot-weather testing in camouflaged prototypes. If the air conditioning works in Death Valley, it works anywhere. As inhospitable as this place may be, its topography is like an amusement park for hikers, campers and gearheads looking to get a little dirty. This 3.4-million-acre national park on the California-Nevada border has trails ideally suited to our mission: testing dual-sport motorcycles.

*
The most powerful bike in our test, the KTM 450 EXC, has torque to burn.

THREE DAYS IN DEATH VALLEY. → by Larry Webster → photographs by Nathaniel Welch

Dual-sport bikes are like the crossover SUVs of the motorcycle world. They are off-road bikes toned down and made legal for road use. Since weight is the enemy of off-road riding, they are all “thumpers”—torque-rich, single-cylinder machines that conservatively sip fuel. So, they’ve become popular bikes for commuting. In fact, last year, the dual-sport segment grew 23 percent. Impressive, considering that the motorcycle market as a whole declined by 3.3 percent.

Our group of riders rambles into Death Valley National Park and convenes at the rustic Furnace Creek Ranch one early spring weekend to kick up some dirt. Our skill levels are as diverse as the bikes we’re testing. The Honda CRF230L and Yamaha XT250 represent the popular entry-level class. The Kawasaki KLX250S and Suzuki DR-Z400S are two consecutive upward steps in capability. Finally, at the extreme end of the performance envelope sits the KTM 450 EXC, a race-ready dirt rocket. Professional tester Danny Coe has blasted each one down the quarter-mile at Auto Club Raceway in Pomona, Calif., before we arrive in Death Valley. So we have an idea which ones will take a more experienced hand.

And our guest rider has spent a large part of his life on two wheels. Joining our team for this three-day trail test is part-time motorcycle rider and full-time MythBuster Jamie Hyneman. Jamie gravitates right to the fire-breathing KTM—it became his favorite steed on this trip.

→ Rocky Roads

THE TRAILS OF DEATH VALLEY RADIATE OUTWARD LIKE A pinwheel from our Furnace Creek home base. Dual-sport bikes don’t have to be hauled to the trailhead like a dedicated dirt machine. You just saddle up and ride. And to get in a full day of riding, we begin at the coldest part—early morning.

The stunning, snow-covered Panamint Range is a welcome distraction from the chill. Still, a 30-mile pavement ride reminds us that these bikes do have some drawbacks. There is no bodywork to shield you from wind. The seats pack all the comfort of a park bench. And the knobby tires put little rubber on the tarmac. So these bikes certainly aren’t cushy cruisers. But it’s that upright riding position that makes dual-sport bikes so maneuverable—and perfect for the dirt.

The packed gravel road leading to Titus Canyon drops into an ever-narrowing switchback canyon. The road itself is mild. A rental car could make it—very slowly. But at the speed we’re going, the constant washboard bumps would probably shake a car dashboard into a pile of crumbled plastic.

These bikes have suspension travel to spare, so they soak up the ridges and allow us to race through to more challenging terrain. All of these bikes occasionally spit fist-size rocks. But when you’re dressed in a suit of armored Alpinestars gear, as we are, you’re nearly bulletproof.

Down in the canyon, as we slice between the high rock walls, the Honda and Yamaha ease us back into the sport. Just about anyone can throw a leg over these bikes; the learning curve is short. But dirt riding requires a subtle touch. It’s

A photograph of two motorcycles on a paved road in a desert landscape. The motorcycle on the right is orange and labeled 'KTM 450 EXC'. The motorcycle on the left is blue and white and labeled 'YAMAHA XT250'. Both riders are wearing full protective gear, including helmets and jackets. The background shows a vast, arid valley with mountains in the distance under a clear sky.

KTM 450 EXC

YAMAHA XT250

tempting to stiffen your arm muscles and make small, frantic steering corrections. Not only will you wake up the next morning with sore shoulders, but these bikes won't respond well to this busywork.

The best way to ride on this terrain is to guide the bikes and forget about small course corrections. It's easier to stand and use your body weight to steer. Once you're in a groove, the moves are graceful, satisfying and quite relaxing. Our group hits that mark as we close in on our lunch stop and glide past the rusty brown and slate-gray canyon walls.

The KLX packs a surprisingly hefty punch. There's a good balance between suspension travel and seat height. And the powerplant is more highly tuned than the other 250s here, so once you spin the motor to its 10,500 redline, hold on.

The deeper we go, the tighter the canyon gets. And nobody wants to let up. The big Suzuki and the KTM both have a wonderful overload of power. The Suzuki is equipped with slightly more street-oriented tires. Yet the motor is ferocious, so lifting the front wheel is just a twist of the throttle away. But the KTM is really in another class. Even with the dirt-specific tires, this bike effortlessly breaks traction, power-slides and sends up a sky-high roost of dirt. We quickly nickname it the Big Block. For those of us with less experience, the KTM can be a bit intimidating. But Jamie can't get enough of it. (By this time, the MythBuster has long since dispelled any doubts about his riding prowess—the man has serious off-road chops). The KTM is “a barrelful of monkeys,” he says, in one of those anachronisms that some-

how sounds natural coming from under a handlebar mustache. “It gives me everything I can handle.”

We gas the bikes through the last of the switchbacks, dirt-track style, with the rear ends swinging wide. On the street these would be hooligan moves, but in the dirt, it's just the right way to ride.

➔ Tarmac Ribbons

IT TAKES A DIP IN FURNACE CREEK'S SPRING-FED POOL to remove the day's dusty film. The next morning we emerge fresh and ready to run the curvy pavement to 5475-foot Dante's View. At the top, on this sparkling day, we could use a parka—it's cold. We walk to the edge of the lookout and see both the highest and lowest places in the contiguous U.S. Roughly 80 miles west is 14,494-foot Mount Whitney; on the valley floor, 282 feet below sea level, the Badwater Basin spreads out like a chalk-white desert.

The chill melts away as our convoy snakes down to Badwater. On this billiard-table-smooth two-laner, the smaller Honda and Yamaha struggle to maintain 70 mph. The KTM has no such trouble. But oddly, the KTM's saddle is not particularly well-suited to ... sitting. It's rock-hard and narrow.



↑
Four members of the PM test team take turns sampling a range of dual-sport bikes on Death Valley's Artist's Drive. Above, the full group takes in a vista that includes the lower 48's highest and lowest points.

KAWASAKI KLX250S

SUZUKI DR-Z400S

Specifications and Test Data



■ SUZUKI DR-Z400S

Price: **\$6099**
 Engine/trans: **398-cc liquid-cooled single/5M**
 Horsepower: **35**
 Weight: **317 pounds**
 Suspension travel, F/R: **11.3/11.6 inches**
 Seat height: **36.8 inches**
 0–60 mph: **5.9 seconds**
 1/4-mile: **14.72 seconds @ 83.72 mph**
 60–0 braking: **133.95 feet**
 Fuel economy: **46.68 mpg**

THE GOOD

→ It has nearly all the punch of the high-powered KTM, so it can keep up with highway traffic. The power allows you to effortlessly work the rear end in the dirt. But it's as docile as the smaller bikes. The DR-Z400S was the only bike here with vibration-damping rubber foot-peg inserts. The suspension's initial compliance did a solid job smoothing out the bumps. And this bike has been around for a while, so there's tremendous aftermarket support.

THE NOT-SO-GOOD

→ It's the heaviest bike here, and the high center of gravity combines with the tall seat to create a struggle for shorter riders. For serious off-road duty, it needs more aggressive tires. Some noticed a sharp, uncomfortable edge in the seat foam.

THE BOTTOM LINE

→ A terrific all-around motorcycle that can be modified to suit almost any rider taller than about five-foot eight.

BEST SUITED FOR

→ Beginner to expert.



■ HONDA CRF230L

Price: **\$4999**
 Engine/trans: **223-cc air-cooled single/6M**
 Horsepower: **14**
 Weight: **267 pounds**
 Suspension travel, F/R: **9.0/6.3 inches**
 Seat height: **31.9 inches**
 0–60 mph: **10.81 seconds**
 1/4-mile: **17.64 seconds @ 68.66 mph**
 60–0 braking: **130.68 feet**
 Fuel economy: **54.16 mpg**

THE GOOD

→ The controls all have a light, progressive feel that makes operation effortless. The wide, soft seat is a comfortable perch. The smaller dimensions give inexperienced riders confidence. And when it comes to reliability, the Honda is probably bulletproof.

THE NOT-SO-GOOD

→ The engine could use at least another 5 hp, and our inner gearhead wants more exhaust growl. With tires biased for on-road performance and short suspension travel, the CRF isn't a hardcore off-roader.

THE BOTTOM LINE

→ It's easy to ride, forgiving—and fun. But it was the 54 mpg and the under \$5000 price that really made us smile.

BEST SUITED FOR

→ Beginner to intermediate, and anyone who values a low seat height.



■ KAWASAKI KLX250S

Price: **\$4999**
 Engine/trans: **249-cc liquid-cooled single/6M**
 Horsepower: **20**
 Weight: **278 pounds**
 Suspension travel, F/R: **10.0/9.1 inches**
 Seat height: **35.0 inches**
 0–60 mph: **8.60 seconds**
 1/4-mile: **16.64 seconds @ 73.54 mph**
 60–0 braking: **127.61 feet**
 Fuel economy: **49.27 mpg**

THE GOOD

→ An excellent compromise between easy-to-ride play bike and full-fledged racer. Suspension is set at a comfortable height, but still has plenty of travel to absorb large hits. It feels light and flickable—great on twisty roads. Clutch and brake effort are wonderfully smooth. Unlike most of the bikes here, the KLX comes with a tachometer. Amazingly, the Kawasaki costs the same as the beginner bikes here.

THE NOT-SO-GOOD

→ The high-revving engine has to be wound hard to gain sufficient thrust. While the liquid-cooled engine clearly provides more poke than the other 250s, it also has more stuff—radiators, water pumps—that could fail.

THE BOTTOM LINE

→ The KLX is docile enough for a newbie, but provides a wide-enough performance envelope to keep an advanced rider entertained.

BEST SUITED FOR

→ Beginner to expert.

The Suzuki, on the other hand, provides plenty of thrust and comfort—it is the grand tourer of the group.

Badwater's glowing white surface practically sears our eyeballs when we remove our helmets for a closer look. NASA-strength sunblock wouldn't have been enough. The basin is not unlike Bonneville—smooth and salty. But this is not a place for speed, unless you plan to compete in the Badwater Ultramarathon. We'll pass. The temperature rises a tick over 90 degrees as we feel the crunch of the salty crust

beneath our boots. That's not Death Valley hot, but it's uncomfortable enough for us to mount up and seek relief.

→ Last Man Out

WE HAVE JUST ENOUGH DAYLIGHT TO RACE OUT TO THE abandoned Inyo gold mine, a quick buzz up a 10-mile trail. If we were crawling in a four-wheel drive, it'd be dark by the time we arrived. Sometimes, two wheels are better than four.

The last gold miners left approximately 70 years ago, but



■ YAMAHA XT250

Price: \$4690
Engine/trans: 249-cc air-cooled single/5M
Horsepower: 16
Weight: 271 pounds
Suspension travel, F/R: 8.9/7.1 inches
Seat height: 33.0 inches
0–60 mph: 9.82 seconds
1/4-mile: 17.20 seconds @ 70.63 mph
60–0 braking: 143.80 feet
Fuel economy: 52.77 mpg

THE GOOD

→ The Yamaha was the least expensive bike here, but it certainly didn't feel cheap. While it has just two more horsepower than the Honda, our test team noticed the XT250 felt much stronger. "The Yamaha is small but gutsy," Hyneman says. The XT250 proved to be a great rock crawler, and with almost no learning curve and near 53-mpg fuel efficiency, it's probably a great commuter too.

THE NOT SO GOOD

→ The distance from the seat to the foot pegs is 19.5 inches, the shortest here. So if you are 6 feet tall, this makes for a cramped cockpit. The rear suspension seemed too soft for heavier adults. Like the Honda, fast and rough off-road riding overwhelm the suspension's damping ability, and the motor doesn't have enough power to keep pace with the bigger bikes on the highway.

THE BOTTOM LINE

→ A near twin to the Honda but in a more powerful, more intermediate-level package. For an extra \$1400, Yamaha offers the WR250R with a lot more giddyup—a better choice for hardcore dirt riders.

BEST SUITED FOR

→ Beginner to intermediate.



■ KTM 450 EXC

Price: \$9198
Engine/trans: 449-cc liquid-cooled single/6M
Horsepower: 43
Weight: 251 pounds
Suspension travel, F/R: 11.8/13.2 inches
Seat height: 38.8 inches
0–60 mph: 5.19 seconds
1/4-mile: 13.84 seconds @ 92.94 mph
60–0 braking: 150.59 feet
Fuel economy: 45.41 mpg

THE GOOD

→ The motor is incredibly responsive and emits an authoritative, barksy exhaust note. We admire the attention to detail with common fastener sizes for quick maintenance and disassembly. The KTM can supply as much performance as the rider can handle, which can be incredibly entertaining. With street tires, it would be even quicker.

THE NOT-SO-GOOD

→ It feels happiest in max attack mode, when you're hard on the gas and pounding

bumps. When cruising, the long travel suspension is surprisingly harsh, and the narrow, hard seat is not suitable for extended rides. The knobby tires make for a tiny contact patch—road traction is limited.

THE BOTTOM LINE

→ Brash and intimidating for novices, but has a potential unmatched in this group.

BEST SUITED FOR

→ Expert or advanced intermediate riders looking to grow into the sport.

there's still plenty of hardware strewn about. We spot a mineshaft up a steep, rocky trail and hop on the Yamaha. The XT250's docile motor happily loafs along, allowing us to crawl up the treacherous hill. And the Yamaha's low seat makes the precarious turnaround easy.

We fill up one last time at the gas station next to the hotel bar. We have burned 20 gallons total—for five bikes—over 200 miles of weekend exploring. Not bad. We park the bikes, dust ourselves off and head inside for a post-ride dinner. The

beer and steak taste so much better after a day out on the trail. Suddenly, midway through a pull of my second Sierra Nevada, the music dies. Power outage. We can hear the howling wind and see the windows clouded with a thick, tan fog. "Nothing but a dust storm," the bartender says. "But it's the worst I've seen in a long time." This is just the kind of unpredictability that makes the region such a bewitching place to ride. Still, there are times when Death Valley is best experienced from indoors.

PM



2009

BACKYARD

GENIUS

AWARDS

To create an incredibly cool car-crusher or oversize rocket or solar-pedal-powered contraption that the world had no idea it needed takes brilliance, determination and a healthy dose of crazy. The winners of our Backyard Genius Awards have all those qualities, and we salute them for it. **BY DAVIN COBURN**

FIRMEST HANDSHAKE

GRAND
CHAMPION

Car-Crushing Mechanical Claw

Our top prizewinner spent years dreaming of the perfect way to crush cars by hand. In 2007 Christian Ristow, an artist and former animatronics designer for the movie industry, demonstrated his first working incarnation of the Hand of Man at a robotics festival in Amsterdam. Much of his time since then has been spent re-engineering and refining the design of the 27-foot-long hydraulically actuated appendage, exhibiting more and more capable crushers at a series of public venues. Ristow's

PHOTOGRAPH BY DWIGHT ESCHLIMAN



latest mechanical steel limb has 90-degree wrist rotation and improved mobility in the finger joints. It is powered by a 90-hp Perkins 1104C-44T four-cylinder diesel engine and is controlled through a glove worn by the operator. At demonstrations, that operator is usually a random member of the audience. "I've built other large-scale radio-control robots for shows over the years, but I always felt like I was the one having the most fun," Ristow says. "This democratizes the crushing power."

MAN BEHIND THE MACHINE

Name: Christian Ristow **Age:** 39

Location: Taos, N.M.

The trouble with Muppets: Ristow once built puppets for Jim Henson's Creature Shop, but was disappointed by the company's "antimechanical bias."



MOST ANIMATED SERVOS

Minimalist Robot

I-Wei Huang animates video games for a living, but he spends his free time animating metal and plastic. His first creations were a series of steam-powered remote-control machines, including mini tanks, a rowboat and a version of Star Wars' R2-D2 that Huang named R2-S2 (the S is for steam). But after more than 20 steambots, Huang changed direction to create mechanical creatures of a totally different character. "Coming from the animation background, I wanted something with personality that I could bring to life," he says. Huang's more recent creations, called SwashBots, are built around parts that control the pitch of R/C helicopter blades. The minimalist robots run on AA batteries and have three servomotors to control the legs and a fourth to move the head. The stutter-stepping little bots squeeze maximum charm out of minimum complexity.

MAN BEHIND THE MACHINE

Name: I-Wei Huang **Age:** 37

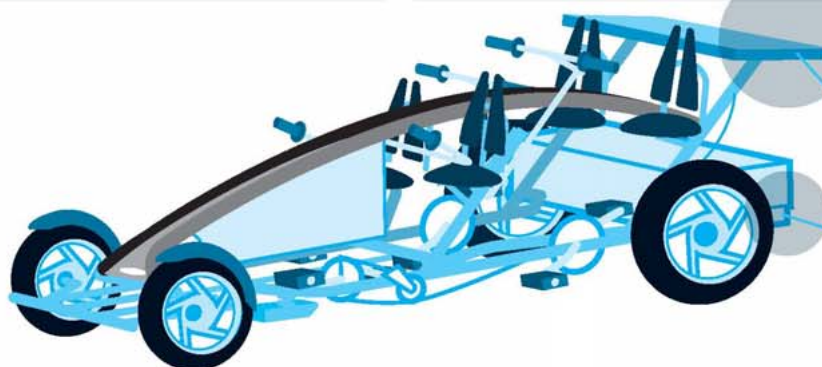
Location: Dixon, Calif. **SwashBot's first steps:**

"I didn't know it would be able to walk like that," Huang says. "I would have been satisfied if it just leaned from side to side. When I saw it turn and shuffle, it made me smile like a toddler."



BEST SCHOOL PROJECT

Solar Quadricycle



Solar power is collected using two 20-watt panels

A 1-hp permanent-magnet motor provides electric assist

David Dixon worked for a year on his eighth-grade project, the Solar Human Hybrid quadricycle. The junior-high-schooler and his father, also named David, drew on their background in alternative energy—the family had previously lived on a sailboat with solar panels and a wind turbine—to create a vehicle that runs on sunshine and sneaker power. Starting with an obscure four-seat Swiss bike called a ZEM, they figured out how to add solar panels and an electric motor. "Dad taught me about amp-hours, volts, watts, batteries and all the electronics we were using," the son says. The SOHH qualifies as a motorized bicycle; following federal and state guidelines, the Dixons equipped it with a 1-hp motor and geared the bike not to exceed 18 mph at full throttle. The project earned the creative teen national publicity and invitations to multiple tech festivals. But his teacher only gave him a B. We're not grade grubbers, but c'mon!

KID BEHIND THE MACHINE

Name: David Dixon

Age: 14

Location:

Novato, Calif.

Room for five:

The SOHH quadricycle has seating for four humans and one dog—the dog is not required to pedal.



GNARLIEST KNOCKOFF

Homebuilt Batman Tumbler

Batman begins, but Bob Dullam continues. The 57-year-old sculptor was so inspired by the Tumbler Batmobile from the fifth movie in the modern franchise that he built a full working replica in his garage in Kalamazoo, Mich. "Other people build sports cars," Dullam says, "but I wasn't that interested in a Corvette. I like Batman—and the only way to get this car was to build it myself." Basing his work on hundreds of fan photos found online and the extra features from the *Batman Begins* DVD, Dullam fabricated a steel chassis and created body plates from epoxy reinforced with fiberglass mat. Dullam's Tumbler is 15 feet long, 5 feet high and 9.5 feet wide at the rear. The 5000-pound vehicle uses a 350 Chevy V8 HO Deluxe to spin its 44-inch Super Swamper tires. Dullam estimates he's spent \$50,000 to \$70,000 on the car—and happily says it's not for sale.

MAN BEHIND THE MACHINE

Name:
Bob Dullam
Age: 57
Location:
Kalamazoo,
Mich.

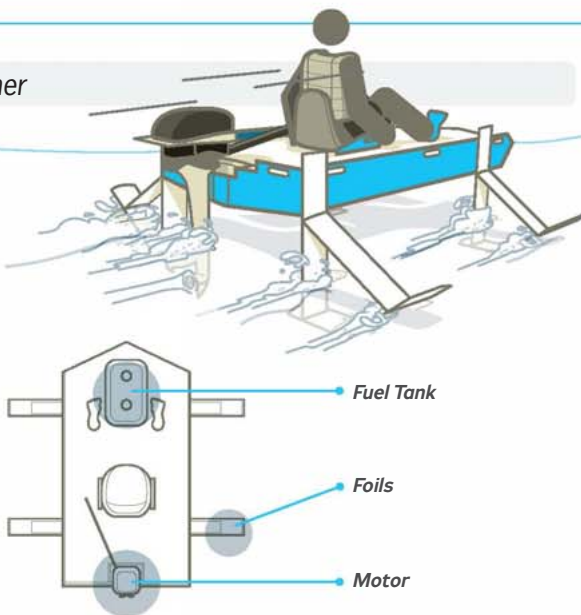
Why done is a state of mind:
Next, Dullam will add the internal Batpod from *The Dark Knight*—and maybe pyrotechnics. "I haven't got flames shooting out the back yet," he says.



CRAFTIEST RAFT

Mississippi Skimmer

Inspired by a hydrofoil he saw on the cover of *POPULAR MECHANICS* more than 40 years ago, Gary Sloat built one of his own: an 8-foot-long foam-and-plywood boat he calls the Dragonfly. The pine foils, which hold riders 2 feet off the water, are joined with biscuits and reinforced with epoxy and fiberglass cloth. With its original motor, the Dragonfly topped out at 25 mph. But it turns out 25 mph was plenty fast considering that the throttle on the antique 1947 10-hp outboard Mercury Hurricane had a habit of sticking whenever Sloat had the boat pointed toward shore. A new 9.5-hp motor is proving to be far more controllable—still, Sloat's family prefers to let him ride atop the waters of the Mississippi alone. "I've got daughters who are 10 and 5," he says, "and my wife's not interested in submitting them to dad's deathtraps."



MAN BEHIND THE MACHINE

Name: Gary Sloat
Age: 48
Location: Davenport, Iowa
Rap sheet: Police shut down Sloat's initial test run at the nearby Sunset Marina. "I got pulled over for making waves in a no-wake zone," he says. "Clearly the Dragonfly worked."

BEST MOBILE DEVICE

Off-Road Rover

MEN BEHIND THE MACHINE

Names: Roger Fontaine and Roger Fontaine
Ages: Dad, 62; son, 29
Location: Splendora, Texas
MythBuster take: Adam Savage salutes Fontaine's dedication to his son. "Plus," he says, "the vehicle is really cool."

Roger Fontaine lives with his parents north of Houston. Muscular dystrophy has left him with only limited movement in his feet, right hand and neck. He devours science TV programs and technical magazines, and was eager to develop a way to be more mobile outdoors. He and his father, Roger senior, who repairs heavy equipment for a construction firm, designed and built the joystick-controlled "Gecko" articulating ATV. The four-wheel-drive vehicle is built around a pair of beefy

transaxles the younger Fontaine found on the Internet, and a 22-hp Briggs & Stratton V-twin engine. Then they added a hinge in the middle that affords the Gecko a 26-inch turning radius, a third as big as many other ATVs. "We wanted him to be able to go around trees," Roger says, "but sometimes the ground is uneven, and we needed all four wheels on the ground all the time." They also added a hitch to hook up small yard equipment to the Gecko—because, unlike many guys, the younger Fontaine actually likes mowing the lawn.





BIGGEST BOOSTER

Saturn V Rocket Replica

Just before 1 pm on Saturday, April 25, 2009, a Saturn V rocket carried one more man into history. Steve Eves broke a slew of world records when his 1:10 scale model of the historic rockets that launched the Apollo missions lifted off from a field on Maryland's Eastern Shore. The 36-foot-tall rocket that Eves built in his garage near Akron, Ohio, was the largest model rocket ever launched. At 1648 pounds, it was also the heaviest privately funded hobby rocket ever launched and the heaviest ever to be successfully recovered. It drew a crowd estimated at 5000—the largest ever to witness a hobby rocket launch. Eves's single-stage behemoth was constructed of aircraft-grade plywood and lauan plywood coated in fiberglass and powered by nine motors—eight 13,000 newton-second N-Class motors and a 77,000 newton-second P-Class motor. All told, the array generated 7 g's at liftoff and sent Eves's Saturn V 4441 feet into the air. "I didn't start out to break records," the 51-year-old autobody repair specialist says. "I had just been working away—and then one day I realized no one's ever pulled this off before."

MAN BEHIND THE MACHINE

Name: Steve Eves
Age: 51

Location:
Uniontown, Ohio

Where to see it:
NASA plans to display his rocket at the U.S. Space & Rocket Center in Huntsville, Ala., beneath an original Saturn V.



SLICKEST SLALOM

Uphill Racer

A lifelong downhill skier and industrial mechanic/millwright, Jim Maidment was frustrated by the fact that he could pursue his favorite pastime only near a chair lift. "When you're on a slope, all that energy is free—as long as you're going in that one direction," he says. So Maidment hacked together a 6.5-hp generator engine (bought from Costco for \$125) with a small, off-the-shelf snowmobile track from Bombardier, inventing a machine he calls the Skizee. He then headed for the mountains to refine his creation, moving from Ontario to Kimberley, British Columbia, Canada's second-loftiest city. So far, he's decreased the size and added a variable torque converter to change the power ratio and climb hills. His latest Skizee can go 12 mph uphill and can reach 25 mph in flat powder. Maidment continues to test his invention in the snowy woods around his home, and he's making final tweaks to the design now. One day he hopes to see the Skizee in pro shops everywhere.

MAN BEHIND THE MACHINE

Name: Jim Maidment

Age: 47

Location: Kimberley, British Columbia

Quick fix: The Skizee has been simplified so that spare parts can always be carried by the rider. Says Maidment: "This better be easy to fix when I'm 10 miles into the woods."

The Skizee is powered by a 6.5-hp generator engine.

Handlebars retract, then fold to make the Skizee small enough to fit in the back of a truck.

By pushing rather than pulling the skier, the Skizee allows its operator to steer with his skis.



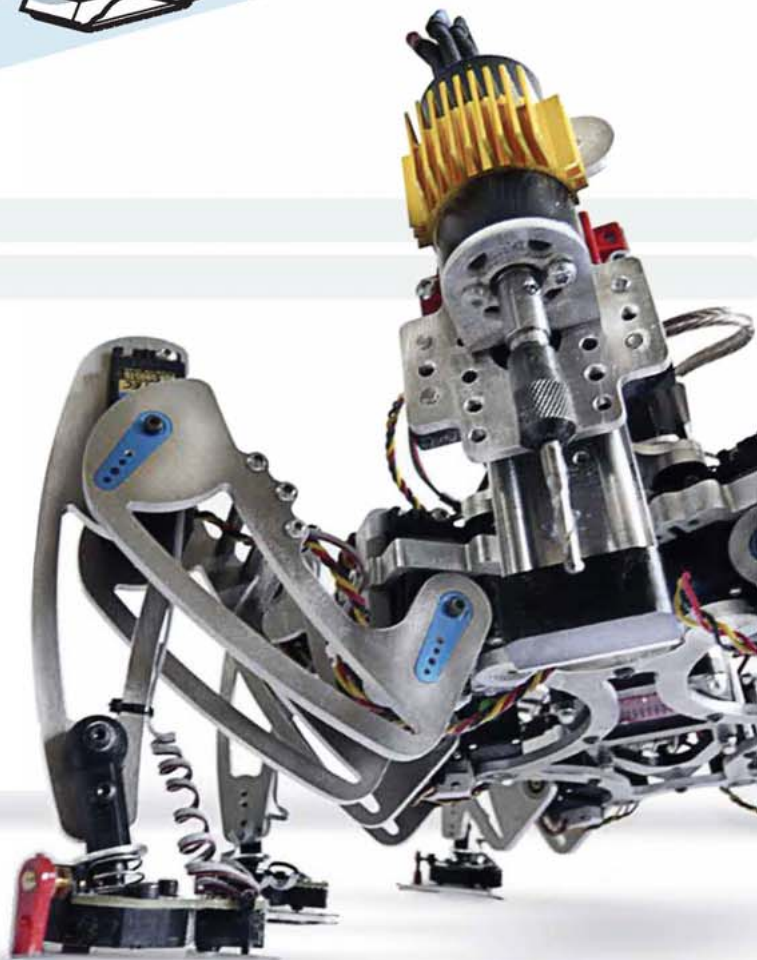
GROOVIEST TOOLBOT

Walking Robot Router

Matt Denton's company, Micromagic Systems, has built six-legged, insectlike bots for the movies (his creations have appeared in multiple Harry Potter films). But in his spare time he experiments with ... more six-legged robots. In a flash of ingenuity, the London-based robotics engineer recently turned a small hexapod robot into a walking, computer-controlled milling machine. When fed instructions over a wireless Bluetooth connection, the dinner-plate-size bot with a drill bit for a head saunters over to a block of polystyrene and begins to methodically carve 3D shapes into the material. So far, the little robot specializes in sculpting human faces. Currently the router takes 1/8-inch bits, but Denton is working on a 3-mm version; he's also hoping to beef up the bit's vertical travel, which is currently limited by the servo to somewhere between 40 and 50 mm. "I've had some companies approach me for practical applications of the robot," he says, "but I never made it with a practical application in mind. It was just a case of 'why the hell not?'"

MAN BEHIND THE MACHINE

Name: Matt Denton **Age:** 36 **Location:** Winchester, Hampshire, U.K. **MythBuster take:** "It can in theory make large fixed CNC machines obsolete," Jamie Hyneman says. "The concept is hugely powerful when you think about it."





STRONGEST HOME BREW

DIY Fuel Mill

Ben Peterson wants to sell the world on turning its garbage into fuel. The 31-year-old former welder recently tore down a farmhouse on his 20-acre farm in Washington state. "We were left with piles of wood," he says. "And I realized that with a gasifier, I could turn that wood into fuel." He found Federal Emergency Management Agency plans for a stratified down-draft gasifier, which uses a controlled combustion process to turn biomass into fuel for first responders. But the FEMA device was enormous, so Peterson spent two months redesigning filters and streamlining the airflow to get it down to a more family-friendly size. "I was making these things out of garbage cans and spare pipe, and I got addicted to the design process," he says. The result is a DIY home gasifier that can power a portable generator. Now Peterson hopes to sell his design to the masses—and his work won't be done until we're all filling up our gas tanks with gasified garbage.

MAN BEHIND
THE MACHINE

Name: Ben Peterson Age: 31 Location: Toledo, Wash. Expansion plan: Peterson has also created an industrial-size gasifier with help from the University of Florida.

PHOTOGRAPH BY SIAN KENNEDY





IN OUR OWN BACKYARD

With a little help from PM and friends, Rebuilding Together is rebuilding its own homebase one step at a time.

They came one morning to demolish it, just as they had done with so many other houses in New Orleans. After Hurricane Katrina in 2005, some houses just couldn't be saved and so the city sent in demolition teams. It continued when Hurricane Gustav came roaring in September 2008.

But a house on St. Ferdinand Street in the St. Roch section of New Orleans would not meet that same fate. There's a group of people from Rebuilding Together New Orleans (RTNO) who wouldn't let that happen.

REBUILDING TOGETHER: TO PRESERVE AND REVITALIZE.

Rebuilding Together is a national non-profit organization whose mission is to fix and develop safe, energy efficient homes and revitalize communities for low income Americans. Rebuilding Together is able to provide services for free by receiving sponsorships and donations from numerous companies across the country, such as Popular Mechanics, as well as utilizing local volunteer labor and materials.

In New Orleans, Rebuilding Together has joined with AmeriCorps to provide a volunteer base dedicated to carrying out its mission and rebuilding the Crescent City.



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CALLING ON AMERICORPS

AmeriCorps was signed into law in 1993 as part of the National and Community Service Trust Act to help Americans in need. AmeriCorps combines two existing service programs, VISTA (Volunteers in Service to America) and NCCC (National Civilian Community Core) to form an all-encompassing service organization that has seen more than 540,000 people serve since 1994.

Each year, AmeriCorps provides the service of nearly 75,000 volunteers on local, regional and national levels. Volunteers can get involved with part-time, local programs (900 hours over a 1 to 2 year period) or full-time, residential programs (1,700 hours over a 9 to 12 month period).



A TYPICAL DAY

Each day, the AmeriCorps members in New Orleans arrive at their warehouse at 7:30 a.m. The warehouse has a central office and stores all of the supplies, tools and resources needed to rebuild houses. The property also has a salvage yard which holds much of the materials the teams find as they rebuild.

AmeriCorps members get their assignments for the day and then head out in teams to their work site around 8:00 a.m. Many days, team members lead a group of volunteers who come into New Orleans to lend a hand.

The work is in no short supply, but resources are. As Daniela Rivero, Field Operations Director, explains, projects are constantly in motion. "We have 33 projects going on right now. Ideally, we want to have just 30 at one time because of resources. Resources are a challenge. The whole Katrina thing has worn off. The funds are disappearing. The help is going away."



DELTA FAUCET

Delta Faucet, a worldwide leader in faucets and related accessories, believes that there is a better way to live with water that goes well beyond design. Its product line incorporates smart thinking that anticipates people's needs. At the 2009 Kitchen and Bath Industry Show, Delta® introduced a revitalization of its award-winning Water-Efficient Showerheads with H2Okinetic Technology®. At an efficient 1.5 gallons per minute (gpm) at 60 pounds per square inch (psi), the showerheads deliver a warm, drenching shower – offering consumers a smarter way to conserve water without compromising comfort. Visit www.deltafaucet.com for more information.



OLYMPIA TOOLS

Olympia Tools develops, markets, and distributes high quality hand tools at affordable prices. Their PowerGrip® Wrench won the Blue Ribbon at the 2007 National Hardware Show. This revolutionary tool offers a complete one-hand operation — attaches to the pipe in one smooth motion; ratchets, which is especially useful near walls and enclosed spaces; and detaches with a convenient thumb activated release button, all while delivering the strength and grip workers need to get the job done and move on to the next project. Visit www.olympiatools.com for more information.

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A TYPICAL MEETING
OF AMERICORPS
VOLUNTEERS.

After setting up the site and training the new volunteers, the team begins working on whatever is needed for that day. Some days it's carpentry. Some days it's painting or hanging drywall. Around 3:30, the team packs up and heads back to the warehouse to unload. By 4:30 or so, the volunteers are free to do as they please.

BEHIND THE SCENES

"I've been telling my friends and family back home that this is the best year of my life so far," says Kate Fey, one of the many AmeriCorps members in New Orleans. "I feel incredibly empowered, I feel excited about the work I'm doing. I love getting my hands dirty, I love coming home covered in dirt. But I know that I've done really good work and I've helped a lot of people out."

The work and living conditions can be tough. New Orleans' climate doesn't exactly help matters. During the summer months, volunteer numbers tend to drop because of the weather. "The toughest thing has been the heat," says Kate. "Today, it's 95 degrees with a lot of humidity, so it feels like 110, which is normal for this time of year. Sadly, it gets worse."

AmeriCorps members live throughout the city, often with roommates to help stretch the small stipends they receive. Some have cars and can drive to work, while others rely on bicycles to get around. The members who will be living in the houses bunk up with other members and get by on a tight food stipend. However, no one is complaining, and that's just what is needed. Our volunteers "eat and breathe RTNO," says Rebecca Crenshaw, Special Projects Officer with RTNO and an AmeriCorps VISTA volunteer. "We couldn't make the impact that we do without their dedication and commitment."

SAVING EVERYTHING

RTNO is nothing if not resourceful. Everything is saved, every scrap kept with the idea that everything can be used somewhere down the line. "We re-use as much as we can. We're really good about using salvaged wood," says Kristin Giselson Palmer, Executive Director of RTNO. "So we've organized our storage so that all of the wood, but particularly some of this original wood remains well above the flood line."

Numerous items and supplies are kept in stock — cabinets, paints, flooring and plumbing and electrical fixtures. High quality





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salvaged wood, as well as new lumber, is kept. There is a dedicated tool room that requires a computerized checkout into a data inventory system. The tool room contains a variety of saws, generators, hand tools, flooring kits, drills and most any other tool you can imagine. Each AmeriCorps member goes through a two-week tool training period when they arrive, though much experience is gained on the job.

RTNO's salvage yard takes materials from homes and buildings that were demolished by the city, but can still be used by RTNO and also sold to the general public. "There are things that we want to save and preserve and put back into homes — mantles, doors, windows, iron, pillars," says Ben Vonblon, an AmeriCorps member. "We can resell these to other renovators so that they can redo their home in a way that is traditional to this city. We can then use the money to fund our warehouse and help give our homeowners a completely free home."

A HOUSE OF THEIR OWN

In May 2008, RTNO purchased the house at 1239 St. Ferdinand Street to become a center for RTNO and AmeriCorps members. This is the second of two housing centers. Each one will house 10 AmeriCorps members, as well as serve as a multifunctional building, a store for salvaged materials, a training workshop for volunteers and a location for community meetings and seminars.

The purpose of the house is to "increase our organization's capacity, offer more services to the community and extend our reach in the city," says Rebecca.

It may sound odd to hear of a volunteer organization spending time and money on themselves, but Kristin knew that a central location was necessary in order for RTNO to do be successful and efficient. "Having these facilities on St. Ferdinand just makes our operations so much easier and more efficient," Kristin adds, "There's still so much work we have to do here, so having everyone here, as well as all of our supplies and such, will help us stay constantly in motion."

"This is one of our priorities because we want to move faster," says Daniela. "It just makes such a big difference to have our own place to house them and to use all this space for all these supplies that we need to do our work. We have all these houses that we need to move on, and this house will help us with that. That's why it's such a high priority for us."

WORKING ON THE HOUSE

The house was purchased with the knowledge that it needed some work, having sustained 75% damage from Hurricane Katrina. Then Gustav roared into town. Gustav so damaged the house that it needed to be completely gutted. RTNO would be starting from scratch.

Flood waters had damaged the flooring and walls, and Gustav's strong winds caused the house to lean so badly that the house had to be braced for six months before work could even begin. Many construction companies passed on the job, saying that it wasn't worth fixing, until finally, a shoring company came and braced the house.

With braces in place, work began. The house was essentially taken apart piece by piece. They found that the floor joists and all of the framing was attacked by termites and rotted out, due to the water damage and the age of the



THE ST. FERDINAND HOUSE AFTER HURRICANE GUSTAV. FLOORS, WALLS AND PLUMBING WERE RIPPED APART AND THE HOUSE HAD A SEVERE LEAN.



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house. As they do with all of the houses they work on, great attention was paid to keeping as much of the original structure intact as possible. Jon Lindquist, an AmeriCorps member, recalled that “we kept the windows the same, the doors the same so that we were able to keep up with historical codes that New Orleans has in place for their neighborhoods.”

The upstairs is more intact and authentic than the rest of the house. The ceiling is original, though reinforced — especially once the dozens of pigeons who had taken up residence left the premises.



Electricians, plumbers and other contractors were brought in and the house started to take shape. The upstairs will have two bedrooms with bunk beds, along with two bathrooms. For these thrifty young men and women, getting clean and staying green is important. Thankfully, they'll have Delta Faucets products to help. The bathrooms are furnished with Delta Faucets Dryden Collection Single Handle Lav Faucets — WaterSense® labeled by the EPA because they use up to 32% less water per minute. The showers are fitted with Monitor® 14 Series Showers and H2okinetic Technology's™ Water Efficient Showerheads. The kitchen is supplied with an Allora™ Faucet, featuring the MagnaTite™ magnetic docking, which keeps the spray wand firmly in place with a powerful integrated magnet.

On Saturday, June 27, RTNO and a team of volunteers comprised of PM staff and sponsors set out to work on the house at 1239 St. Ferdinand. In addition to providing sweat equity, sponsors were a critical component of this initiative. Materials were supplied by James Hardie due to their climate-sensitive



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James Hardie siding is America's #1 brand of siding. It proudly unveils a new concept to home building — siding that's engineered for climate. It's called The HardieZone™ System, and it provides siding with specific performance attributes relative to the climate where the product is being used. HardiePlank® lap siding along with trim and a weather barrier create a complete James Hardie Exterior. Visit www.jameshardie.com for more information.



LEE JEANS

Lee Jeans is a leading international manufacturer of denim wear and casual wear. Founded in 1889, Lee Jeans have a broad history of innovation, including the Union-All work jumpsuit in 1913, the first “Overall” in 1920, as well as the zipper fly. Throughout the years, Lee has continued to build on the brand, becoming the nation's leading manufacturer of work clothes. Visit www.lee.com for more information.



KICKER

KICKER has been in the mobile audio business since 1980, manufacturing high-performance car stereo equipment (subwoofers, speakers, amplifiers) and some seriously loud bass. Recently, Kicker has crossed over into Home Audio, creating a new line of high-performance earbuds, headphones, and docking systems for iPod and Zune players. Kicker claims the iKICK dock to be the loudest and best sounding available. Visit www.kicker.com for more information.

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Made by **Shurtape**





construction, which is crucial to the high humidity and moisture of New Orleans' weather. HardieWrap™ Weather Barrier was used specifically to allow any potential moisture to escape, keeping the walls dry. HardiePlank® lap siding was then placed over the wrap to provide strength and durability to the house. The lap siding also made painting a snap, as its smooth texture and construction allowed AmeriCorps members to use just one coat of paint.

Interior walls will be constructed with HardieBacker® 500 Cement Board to continue to protect the house from potential moisture damage and mold growth, two areas of concern for residents of New Orleans and the Gulf of Mexico region. It's safe to say that the great products donated by James Hardie will have a lasting impact on the St. Ferdinand house and its surrounding community.

Using FrogTape to edge the windows made painting the house on St. Ferdinand much easier for AmeriCorps volunteers. This is because of FrogTape's PaintBlock® Technology which produces a micro-barrier when it comes in contact with latex paint, sealing the tape edges shut, and preventing team members from having to scrape and clean off excess paint.

AmeriCorps members tackle a number of jobs throughout the day, so having tools that can handle a variety of tasks can make a big difference. Rapid Tools' Warrior is the first and only tool to combine a utility knife with a hand saw. Winner of A 2009 Popular Mechanics Editor's Choice award, the Rapid Warrior boasts professional-grade construction for durability and a soft grip handle for comfort to give AmeriCorps members a tool that fits their needs.

Another helpful tool is the PowerGrip® Wrench by Olympia Tools. This easy-to-use wrench has a single-hand operation, allowing AmeriCorps members the flexibility to work in tight spaces. Power Grip attaches quickly, ratchets quickly and releases quickly, all while delivering the strength and grip team members need to get the job done and move on to the next project.

Sponsors also made sure that AmeriCorps members were well-covered, protected and entertained. Lee Jeans donated a supply of durable denim jeans to the cause, which no doubt comes in handy to AmeriCorps members who put their clothes through a hard day's work. Revlon contributed various selections of Mitchum Deodorant to keep team members feeling fresh and dry during the day. Kicker's generous product donation included 4 iKick docking stations for the house, that will provide a nice respite after a long day of work or a hearty wake-up in the morning! The big five-inch woofers, 19mm tweeters, and 40-watt stereo amplifiers deliver crisp, powerful sound.



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Popular Mechanics also contributed a significant monetary donation to RTNO to which helped pay for supplies, contractors and other necessities.

SO MUCH DONE, SO MUCH MORE TO DO

Rebuilding Together New Orleans has made such a difference in the New Orleans area. Since Hurricane Katrina hit in 2005, RTNO has restored over 137 housing units. In the time since Hurricane Gustav struck Louisiana only a year ago, over 6,700 volunteers have worked with RTNO and completed 69 homes. More completions are on the way, including the house on St. Ferdinand Street, due to be finished on the fourth year anniversary of Katrina.

Daniela recounts, "When I came to New Orleans in October 2007, it looked like a ghost town. It didn't seem like there was any recovery process going on at all. But when you see this construction everywhere, it has this kind of multiplying effect. When you work on a house and rebuild a neighborhood, the neighbors decide to come back." She adds, "This house that we're working on right now is only going to add to that. Nobody wants to live in a neighborhood that looks horrible, so when you rebuild, other people want to rebuild, too. You can see the town starting to come back."



Through Rebuilding Together New Orleans, you can help this city continue to come back. Visit the RTNO Web site at www.prcno.org/programs/rebuildingtogether to get started. Once on the site, you can donate funds and volunteer to go to New Orleans and help out firsthand. You can make a difference.



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Revlon, known more for its cosmetic products, also produces Mitchum® Deodorant. This line of deodorants for men and women offers powerful protection and a promise to banish white residue from appearing on the body and clothes. The patented water-based formula in Mitchum® Smart Solid™ fights sweat before it starts, while Mitchum® PowerGel™ offers superior strength with OdorGuard technology to eliminate odor-causing bacteria on contact. Visit www.mitchumman.com for more information.



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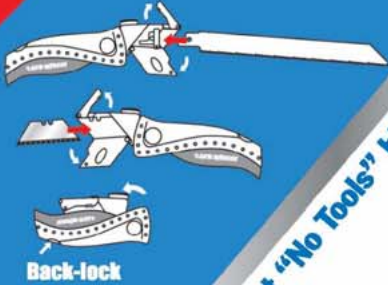
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PM

EDITOR'S CHOICE AWARDS

09

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AT THE PM SCHOOL FOR PUNISHMENT, WE TEST SEVEN RECIP SAWS AGAINST SOME UNUSUAL TEST RIGS.

BY ROY BERENDSOHN

➤ To find the toughest saws, we cut pipe, armored cable, lumber and roofing.

The reciprocating saw is the workhorse of home remodeling. It slices through most common building materials, from cast-iron drain pipe to nail-embedded framing lumber. Its slim profile and narrow blade allow it to work in the most improbable places: inside a chimney chase, under a sink, behind a floor joist. And it

safely handles jobs that no other tool can touch, such as removing a shrub's root ball. To find the tools that excel at this dirty work, we gathered seven saws and leaned on them to simulate worst-case cutting and the day-to-day stuff you'd likely encounter remodeling a bathroom. After a long day of cutting, here's what we found.

HOW WE TESTED

PM's Joe Truini has a knack for building brutal test rigs. Before we cut into his test samples, we equipped each saw with a Lenox Gold Edge Bi-Metal blade. Next, we ripped down the length of a 2 x 8 studded with 12d common nails. To make this rip cut more difficult, the lumber was topped with ½-inch plywood and two layers of roll roofing. After the saws cooled, we chucked a Lenox Extreme Metal Lazer blade into each and crosscut the nested nightmare seen on the previous page—a plastic pipe with a layer of grass carpet glued to its outer wall. Inside, Joe slid a galvanized steel pipe, another plastic pipe, pipe insulation, copper pipe and 10-gauge armored cable. Finally, we did some standard crosscuts.

Roof
RipTIME
TRIAL
in seconds

2 x 6

**Bosch Demolition
Reciprocating Saw RS35**
Price: \$180

Pipe Crosscut: 31.8
Roof Rip: 52.3
2 x 6: 4.3

what we liked

Bosch's automatic blade chuck was the easiest of the seven to employ. Push a blade in and the chuck collar rotates automatically, locking the blade. Rotate the chuck to release. This saw has good grip surfaces and a front hand guard that protects against skinned knuckles.

what we didn't

The saw's foot plate is substantial, but its rotating release lever is complicated. The unobtrusive orbital action needs to be slightly larger, especially for those wearing work gloves.

**DeWalt VS
Reciprocating Saw DW311**
Price: \$170

Pipe Crosscut: 55.2
Roof Rip: 75
2 x 6: 7.6

what we liked

There's a lot to praise in this basic saw. Orbital action? Twist a knob. Speed adjustment? Twist a dial. Blade replacement? Turn the chuck. It's not the fastest saw, but it slogs through tough cuts without heating up. We can't assess durability in these tests, but we suspect its slow and steady nature will help it win the longevity race.

what we didn't

Big Yellow needs a chuck ring that's larger and easier to grip, better vibration damping and a bit more power.

**Milwaukee Heavy Duty
Orbital Sawzall 6538-21**
Price: \$150

Pipe Crosscut: 37
Roof Rip: 41.75
2 x 6: 5.2

what we liked

This is a superb saw, and the addition of a counter-balanced drivetrain has only made it better. A motor upgrade from 12 amps to 15 provides it with even more power than older models. It has a twist-lock cord that's easy to replace if damaged. And the equally easy spring-loaded chuck popped blades in or out, even when we wore work gloves.

what we didn't

Our only complaint is that we can't find anything—not one single thing—to complain about. Where's the fun in that?

RATING

★★★★★

★★★★

★★★★★



Hitachi Reciprocating Saw
CR1 3VBY
Price: \$140

Pipe Crosscut: 36.3
Roof Rip: 67.1
2 x 6: 6.3

what we liked

Hitachi claims that its counterweight mechanism and unique swing orbital action contribute to smoother cutting. We agree. Those features, coupled with plentiful rubber overmold, make it a very smooth operator.

what we didn't

Everything about the Hitachi is well-engineered except, ironically, two of its simplest features. The shoe's movement is cranky, and the blade-lock button is so stubborn that we tore it off with our thumb when we meant to pivot it forward.

★★★★



Rockwell Vibrafree Reciprocating Saw RK3637K
Price: \$150

Pipe Crosscut: 30.6
Roof Rip: 52.3
2 x 6: 5.7

what we liked

This is a reasonably fast and easy-handling saw with large grip areas and good industrial design. To change blades, you push up on the rounded lever that is part of the saw's nose. Insert the new blade in the chuck and pivot the lever down. The emphasis on industrial design makes the Rockwell a good choice for people who wear work gloves while sawing.

what we didn't

If it had been just a little faster overall it would rank right up there with the best of them.

★★★★



Makita Reciprocating Saw JR3070CT
Price: \$185

Pipe Crosscut: 35.3
Roof Rip: 51
2 x 6: 5.2

what we liked

We didn't devise a test for cut neatness, but if we had, Makita would've won it. Its four-position orbital action and variable-speed control allow you to fine-tune its cutting action. This was one of three saws that combine a 15-amp motor and vibration-damping features. The sum of these features is fast and powerful cutting with little vibration.

what we didn't

We couldn't find one stinking thing to complain about, a trait it shared with its esteemed red competitor. Believe me, we tried.

★★★★★



Porter-Cable Tiger Saw 9750
Price: \$205

Pipe Crosscut: 44.5
Roof Rip: 76
2 x 6: 9.7

what we liked

As if a reciprocating saw wasn't already versatile, this machine has a front gear housing that pivots through 12 positions, allowing you to make cuts that would be impossible through conventional means.

what we didn't

This is really a specialized tool for people who routinely make very strange cuts. For normal use, it's simply too slow, apparently a victim of the extra gearing necessary to swing that front housing around. Also, the absence of an orbital action reduces its speed.

★★★★★ for normal use
★★★★★ specialized cuts

Homeowners Clinic

by Roy Berendsohn

Q + A

The Long Reach

Q A couple of years ago we moved into a house with high ceilings, including light fixtures and decorative beams that are all but impossible to reach. It never occurred to us how difficult it is to deal with dusting, light-bulb changing and painting with all this tall architecture. What's the best way to handle this?

A Believe me, you're not alone. These atriums and "great rooms" are designed to wow homebuyers, but homeowners are often less thrilled when they realize that routine maintenance and painting in these areas can require scaffolding. Then there are the convective drafts that form in these tall places, but that's another story.

First, let's look at the cleaning, since that's the easiest to handle. Get a telescoping cleaning pole that has an Acme thread on its end. Typical homeowner models range from 5 to 15 feet, approximately, but there are professional models that can reach as high as 30 feet. Also, get a lambswool or synthetic duster and a wall brush to sweep cobwebs out of tall corners. If you have ceiling fans, get a forked dusting tool. These things will clean both sides of a ceiling-fan blade in one pass.

↑ **Next, light-bulb changing.**

Home centers and hardware stores sell pole-mounted bulb changers equipped with a suction cup or spring-steel fingers, but these devices don't work with chandeliers, which will spin as you fasten the changer to the bulb and turn it. The only way to prevent this from happening is to get a second person with another pole to try and hold the chandelier in position while you spin the bulb loose. Failing that, you'll need either a tall stepladder or a hybrid stepladder that's designed to articulate over a staircase and into corners that are hard to reach by conventional means. Little Giant makes a

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number of ladders that can be configured in this way.

That leaves painting. Sorry, there's no good news here, just hard work. Dust off the high areas before beginning, because you're liable to knock dust loose as you work. The best way to paint tall ceilings and walls without setting up scaffolding is to get some help and set up an extension ladder. Use the ladder to get up to the ceiling-wall corner and cut in the line where the two meet using a brush and a rapid little tool appropriately called a mini roller. Next, paint the ceiling with a long extension pole and a roller (I admit, the job can give you a workout). Finally, paint the walls using the extension ladder to reach the ceiling-wall corner and the extension pole for the high parts of the wall.

Goodbye Molding, Hello Repair

My teenage son managed to take the molding off the garage-door jamb when he was backing out a little too quickly. The car damage was minor but the jamb molding was ripped off. I can't seem to find a replacement. It's one piece with weatherstripping molded onto it. Please don't tell me the thing is sold only with the door.

Relax. The part you're looking for is known as a garage-door stop. Many home centers and lumberyards sell it, but you won't find it with the typical wood moldings. If the store has a section with garage-door hardware, that's probably where it'll be. A garage-door stop is available in two configurations: for the side or the top jamb. Yes, you're correct. The weatherstrip is molded onto it. Depending on its length and where you buy it, it will cost \$6 to \$12.

If your local home center or lumberyard doesn't stock this piece, you can find it at garage-part suppliers online. The full name is: coextruded PVC garage-door-stop weatherstrip.

Metal Chimney Seal

I recently noticed a dirty patch of insulation in my attic. When I peeled

Power-fed rollers are a good alternative for painting large areas in hard-to-get-to places. It saves having to go back and forth to a paint tray from a ladder, which means less drippage and spillage.

— JAMIE



the insulation back, I found a big gap that was letting air through (a large hole had been bored to allow a pipe to pass through the framing). I want to seal this hole with expanding foam. Can I also use the foam to seal around a sheet-metal chimney that passes through the attic?

It's a good thing you spotted that dirt, which is proof that a draft is moving into the attic from the house below. The insulation acts as a filter, trapping the material moving by in the airstream. Sealing the drafts will cut your utility bill, and a little sheet-metal work accompanied by some heat-resistant caulk will make the house more fire-resistant. First, deal with the draft. Spray foam is great for sealing drafts, but that doesn't mean it's also suitable for sealing against the chimney.

"In most cases, you shouldn't use standard foam insulation to seal and insulate against a sheet-metal chimney, or a masonry chimney for that matter," says Michael Casey, an expert on building codes and co-author of *Code Check*, a manual that helps builders, remodelers and homeowners avoid running afoul of these regulations. There are

special foams for this, but unless you're sure that they are permitted where you live, you're better off sealing the air gap between the chimney and floor joists using sheet steel or aluminum flashing. This horizontal air seal is known as fire blocking or draft stopping, and it prevents the spread of fire between floors by sealing air spaces that permit its passage.

Once the metal is in place, seal the remaining gap between the metal's edge and the chimney with a thin bead of high-temperature silicone caulk.

Finally, prepare for adding insulation (foam or additional fiberglass batts) by installing a second piece of vertical sheet metal that provides a 2-inch airspace around and parallel to the chimney. This barrier must be taller than any insulation is deep to prevent insulation from touching the chimney.

There are exceptions to this procedure. In some cases, a sheet-metal chimney that passes through an attic is already surrounded by a protective sleeve that provides the needed airspace. Also, the 2-inch air gap that I recommend is generous for some forms of insulated metal chimney, which only require a 1-inch airspace. Unless you're sure of the type of chimney you've got, use a 2-inch airspace.

"Remember, local building codes always have the last word," Casey says. "Check with your building office before beginning work."

PM

Wagner PaintMate Plus Roller (\$30)



Got a home-maintenance or repair problem? Ask Roy about it. Send your questions to pmhomeclinic@hearst.com or to Homeowners Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.

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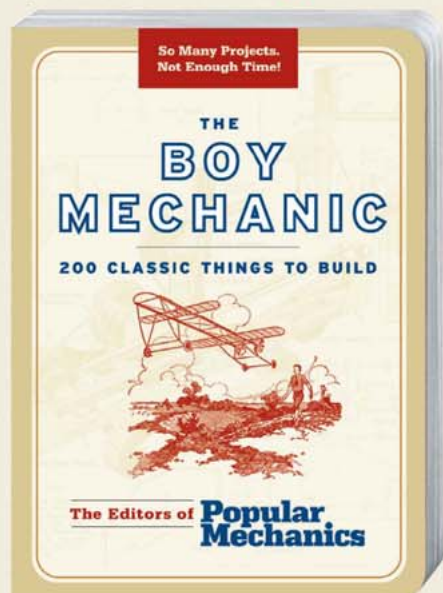
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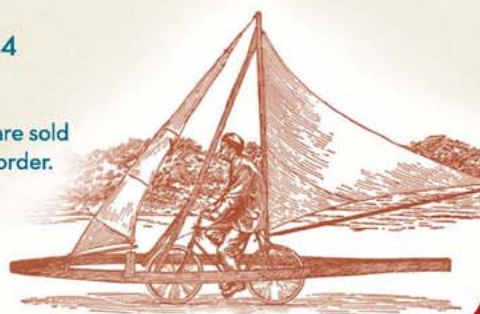


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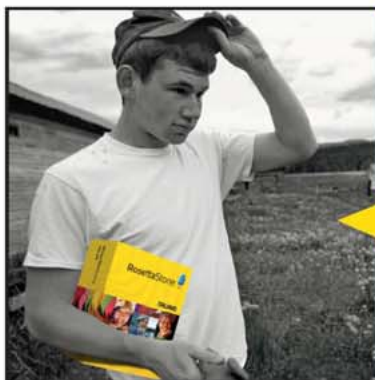
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THE PARTS STORE CAN REPLENISH MOST OF THE SUPPLIES IN YOUR GARAGE. BUT FOR SOME PROJECTS, YOU NEED TO GO A LITTLE FARTHER AFIELD—LEFT FIELD—TO FIND THE RIGHT STUFF. **BY MIKE ALLEN**

An army may march on its stomach, but a mechanic's shop marches on supplies—sometimes, the funkier the better. Every wrench-twister and mad mechanic has a handful of oddball products that he just can't work without. Look at the shelves and cabinets on the back wall of my shop, and you'll see plenty of oils, goops and sprays that I get from the local auto parts store. There's a rarefied air of specialized products not intended for automotive use. I get them from an industrial supplier.



Shopping for garage supplies at the grocery store again?

There's some stuff squirreled away that has no conceivable automotive use whatsoever. We got together with the MythBusters, Adam Savage and Jamie Hyneman, one afternoon, and, sure enough, they've got some weird stuff, or simply ordinary stuff utilized in, umm, unusual ways, on their shelves too.

Marvel Mystery Oil

This product dates back to the '20s, and was touted as a "top oil," something to be added to the gas tank to improve lubrication to the upper rings and the valves. Improvements to engine and oil technology have made it obsolete for that use, but it's my oil

of choice for freeing up a seized engine that's been sitting, salvaged from some vehicle derelict long enough to have a tree growing through the trunk floor. Pour a couple of tablespoons into the spark plug holes and let it sit overnight. The amount of torque you'll need to apply to the crank to break the rings loose will be cut in half. MMO is also good for air tools because it cuts through gummy deposits on phenolic motor vanes. And it makes the whole shop smell minty fresh.

Never-Seez

This thick paste is laced with graphite, copper and lead, in a mineral-oil base. I use it on virtually everything I ever expect to have to take apart again. It's great on exhaust-system parts that slip-fit together. It's perfect for the mating surface between brake discs and hubs to prevent water from intruding, corroding the surface and making the disc difficult to remove. Just brush a little on and smear it around to cover all the mating surfaces.

RuGlyde

Don't mount tires with soapy water or silicone. The water stays inside the tire, causing corroded rims, while the soap makes your tires fizzy the next time it rains. Silicone will let



Chain Lube

↑↑ This stuff foams out of the can, so it penetrates like a light oil and then gels into something sticky that is reluctant to come off a surface. This makes chain lube good for getting into a tight place, especially one that may be exposed to the elements and high speeds. It soaks in, but doesn't run back out after the solvent dries off.

Plumber's Epoxy

↑ Need something plugged? An aluminum casting part broken off? This comes in a Tootsie Roll-size package. You just knead it to activate. It is heat- and oil-resistant, plus it handles a compression load very well.

Cyanoacrylate Glue

→ Sets in 5 seconds, bonds just about everything there is temporarily and instantly. Adam says he never has less than five or six bottles of the stuff: "I get more every time I go to the hobby store."

I can build a surprisingly large structure with only plastic, cyanoacrylate glue and baking soda.

— ADAM



[1] Use the thin, runny cyanoacrylate glue, not, as you might think, the gel type. The little tubes will work, but only for very small repairs. I usually buy 1- or 2-ounce bottles. Use a disposable eyedropper.

[2] Pick up some baking soda by dipping the glue-filled eyedropper into it. Saturate the baking soda with glue, and transfer the mixture to your workpiece. You'll have a few seconds before it starts to harden.

[3] File or sand off any excess material after it cures.

[4] Repeat Nos. 2 and 3 until the missing area is restored. The repaired area can be painted if necessary.

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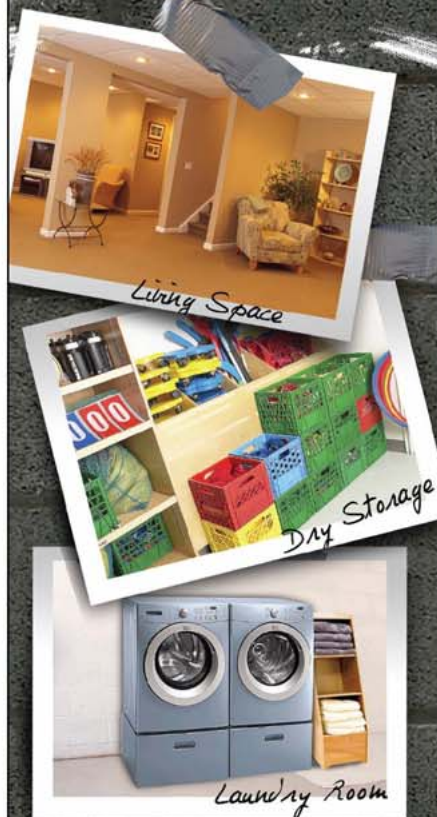
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PM DIY AUTO // WHAT'S ON YOUR SHELF?

Baby-Bottle Nipples

→ Movable shafts or cables need a boot or seal to keep out dirt and water and keep in lubrication. Jamie uses silicone baby-bottle nipples, which have a small-diameter hole at the small end to take the cable or shaft. They're really great for assemblies with a high angle of deflection.



Liquid Electrical Tape

➤ It's intended for use on electrical connections out in the weather. It's also handy to repair bowden cables with disintegrating sheaths, and to keep salt and moisture away from fasteners. My favorite use is as a brushable masking agent for spraying paint. Just peel it off later.



Stainless-Steel Wire

← Jamie recommends baling wire, which is made from thicker, softer steel. (It's called baling wire, for you city guys, because you use it to bale hay on the farm.) Such wire makes a great permanent hose clamp, especially on small-diameter rubber hoses.

the tires spin on the rims and make them out of balance. RuGlyde is a lubricant intended specifically for rubber, and it dries to a slightly grippy film. It's also good for installing handles on tools, or inserting rubber grommets and bushings. Sure, soap—or Jamie's favorite, lard—makes a great lube, but lard stays slippery forever. RuGlyde will also keep rubber black and shiny, but not slippery like Armor All. Ever push down on the brake pedal of a car that's been detailed with Armor All? Dangerous!

Loctite

Sure, this anaerobic threadlocker will keep parts from self-dismantling, but think—if it adheres to the threads to

keep a nut from spinning off, it also fills the voids with polymers, not water and rust, allowing you to remove that nut years later.

Carb Cleaner

It's the universal solvent. Yes, you can use it to clean carburetors and other fuel-system parts, but it's also great for chasing vacuum leaks. Idle the engine and spray carb cleaner near the suspected leak. If the idle peaks up and down, carb cleaner is being sucked into the leak, briefly fattening the lean mix.

I usually prefer carb cleaner for starting balky engines. It works just as well as ether, but it's not as destructive. I once watched a guy blow a connecting rod right through

the side of an engine while trying to start it with ether.

Can't get that tire to seat its bead no matter how much compressed air you blow in? Spray 2 seconds' worth of carb cleaner into the tire, flick your Bic, and *poof!* Instantly seated and inflated tire. If you try this, I won't be responsible for any singed eyebrows or pinched fingers. I reserve this trick for when I'm repairing a flat way out in the woods and the alternative is freezing to death.

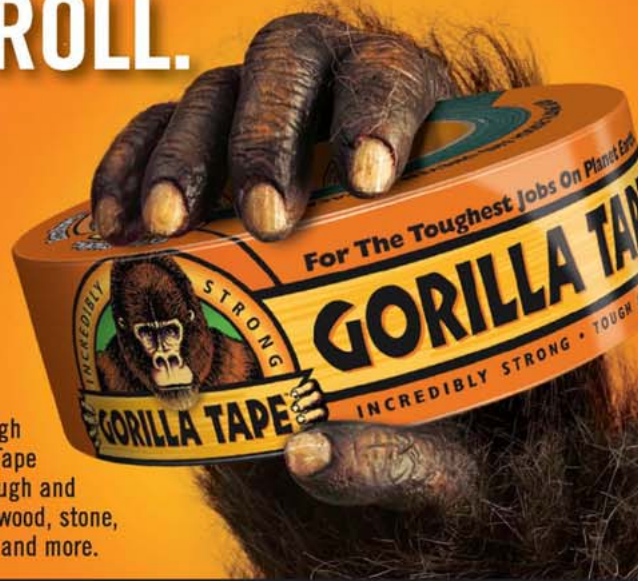
Kano Kroil

It's not a lubricant; it's a penetrating oil. And it will penetrate into and loosen up stuff you'd otherwise have to torch apart. Spray the fasteners with Kroil daily for a week or two. Whack the part with a ball-peen hammer a half-dozen times every day to set up some high-frequency vibrations to pulverize the rust inside the joint. This stuff penetrates stuck parts better than anything I've ever used, which makes the trip to the industrial supply house worth it.

Baling Wire/ Safety Wire

There has been a spool of 0.032-inch stainless aircraft safety wire on the top shelf of my toolbox for 30 years. (Okay, not the *same* one.) I use it for a lot more than lock-wiring fasteners. It's handy for lashing stuff up and out of the way, like a droopy exhaust system or a brake caliper that's hanging around while you're working on the suspension. The thin, stainless wire is handy for cleaning plugged carburetor jets (remember carburetors?), while the thicker baling wire makes a fair toilet snake. **PM**

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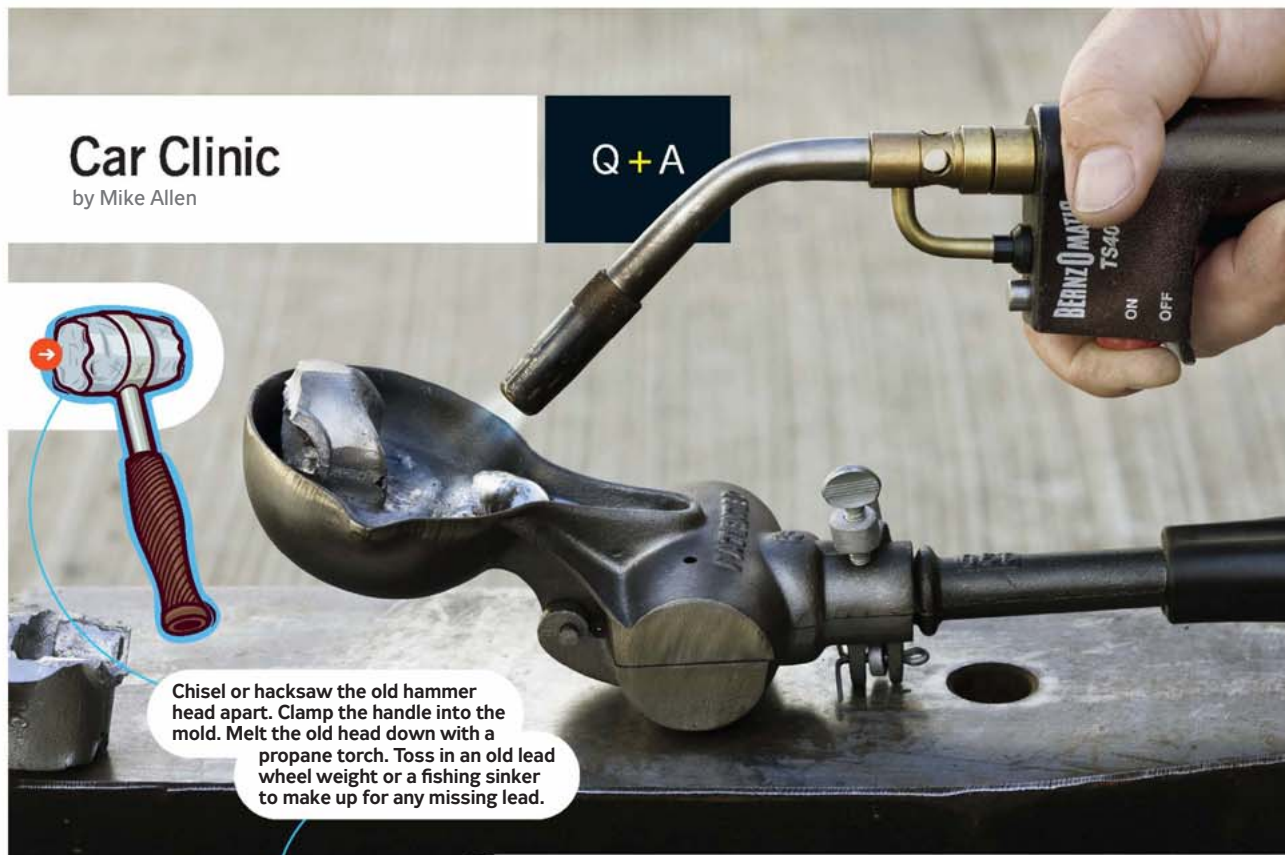
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Car Clinic

by Mike Allen

Q + A



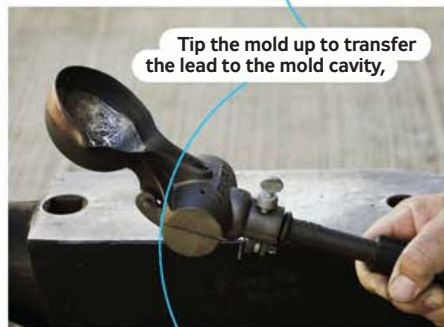
Chisel or hacksaw the old hammer head apart. Clamp the handle into the mold. Melt the old head down with a propane torch. Toss in an old lead wheel weight or a fishing sinker to make up for any missing lead.

Get the Lead Out

Q I used to drive an MGB with knockoff wire wheels, and I had this cool lead hammer to whack the ears on the big nut that held the wheels on. I used that hammer for other things, too. It was great for tapping almost anything made of metal, because it wouldn't leave little hammer marks, no matter how hard you smacked something. Where can I buy one of these hammers today?

A Yeah, I used to have a couple of these, leftovers from scrapped British cars with wire wheels. They're awesome, for the reasons you mention. Problem is, they eventually get

pretty funky, because the lead is so soft the ends become mushroomed. Ultimately, the head gets beat up so badly, it falls off the wooden handle. And that's what happened to mine. You can buy new lead hammers from industrial suppliers but they run \$30 or more—which is a little rich for a tool with a limited life span. But I found this lead-hammer mold in the Graham tools catalog (grahamtool.com). It lets you melt down and recast your old lead-hammer head over and over again. Sure, it's 90 bucks for the set, but you'll only buy it once. They sell spare handles, too, so you can melt down and recycle all those old fishing sinkers, wheel



Tip the mold up to transfer the lead to the mold cavity,

wait 5 minutes, and your lead hammer is like new.



ILLUSTRATION BY KONSTANTIN SHALEV



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Risen From the Dead

My pickup has failed to start on several occasions after sitting overnight. In the morning, the ignition is dead and there is no electrical power at all (interior lights do not work). Then I'll hook up the battery charger and immediately the interior lights come on and the truck will start. It's obviously not the battery as I have purchased a new one and still have the same problem. I've taken it to the GMC dealer and they can't find anything wrong.

It's almost certainly a bad connection to the battery at the posts or the cables. No interior lights or dash lights when the key is turned on means either a completely dead battery, which would take many hours to

charge, or simply an open connection.

The physical act of attaching the battery charger leads is disturbing the battery connections just enough to make the connection, and off you go.

I'm the kind of guy that will leave a meter on the front seat for the next non-start. That will allow me to chase the voltage drop across every connection anywhere near the battery until I find the one that reads 12 volts across the connection, pinpointing the problem. Other folks who may be less curious or less obsessive (you know who you are) will simply clean and tighten all the battery cables.

Don't forget, the problem is just as likely to be the ground side as it is the positive cable.

Saab Story

I have a 2001 Saab that was recently in a front-end accident. The airbags

deployed, but the engine and everything except for the radiator and fan came out unscathed. Even though the damage is mostly cosmetic, our insurance company is going to total the car, because we received a quote of over \$4000 to replace the airbags, along with the sensors and computer—and the entire dashboard—even though I haven't found any damage to it.

Is this normal?

Yes. Most car manufacturers recommend replacing not only the airbags themselves, but the entire airbag system, including the airbag controller, the sensors and all the wiring harness, as well as the dashboard and its underpinnings, if the airbags deploy. Four grand is typical. (Ouch!) The insurance companies are concerned about the possibility of future lawsuits if a repaired car is in a second accident and for some reason the airbags don't deploy. So they prefer to total the car and wash their hands of the whole mess.

No surprise, many of these cars are

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eventually repaired and sold, although they generally must carry a salvage title. Body shops buy these cars from the adjuster, and keep them around to work on in slow weeks, eventually selling them to private individuals or sending them off to auction.

You might try to keep the title and possession of this car yourself and have it repaired. A good shop should be able to make the airbag system as safe as new, by replacing any parts actually damaged with new or salvaged parts. I would specify new, rather than used, airbags.

Moisture-Proof—Not

I have a late-model Chevy Silverado that is used as a daily driver—no trailering or heavy loads. My dealer's maintenance pamphlet suggests changing the brake fluid every 30,000 miles. The dealer claims the brake fluid can absorb moisture and become very hot, thus justifying a change. My vehicle has ABS and it seems to me this could cause more harm than good.

GM agrees with you that brake fluid never needs to be replaced. They seem to be the only manufacturer that doesn't recommend periodic flushing of old fluid. The issue, as you suggest, is water contamination, which lowers the

boiling point of the contaminated fluid to a level where hot brakes might make it boil, reducing brake effectiveness. There are electrical testers and disposable strips to check the moisture content of brake fluid.

But there's a second issue. The brake-bleeder bolts in the calipers or wheel cylinders will eventually freeze

in their threads if they are never loosened. If it ever becomes necessary to bleed the system, they can then be difficult to remove. I recommend semi-annual flushing of old brake fluid. If you watch, and see how the old fluid looks when it comes out (it will look like squid ink, not clear, like new fluid), you'll probably agree.

PM



Got a car problem?

Ask Mike about it. Send your questions to pmautoclinic@hearst.com or to Car Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.

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DIY Tech



To turn this ordinary Dell Inspiron into a ruggedized laptop, we created a shockproof exoskeleton.



Ruggedize Your Own Tech

HOW MUCH FOAM AND PLASTIC DOES IT TAKE TO SAVE ORDINARY GADGETS FROM EVERYDAY DISASTERS?

BY ANTHONY VERDUCCI
AND GLENN DERENE

Portable electronic devices can be subjected to some serious knocks, drops and sticky situations—from tumbles off tables to toilet-bowl splashdowns. In response, an entire subsection of the personal electronics industry has evolved to produce ruggedized tech. These water-resistant, shockproof gadgets are designed to protect delicate circuitry from clumsy spills and from the unforgiving environments of messy

jobs (police work, construction) and outdoor recreation. But they often cost more and skimp on features.

We're so used to giving gadgets beatings in our abusive lab tests that we've often wondered just how much extra tinkering it would take to elevate a garden-variety nonruggedized product into a masochistic gizmo that could take a considerable licking and come back for more. When we raised the question with the MythBusters, Jamie Hyneman and Adam Savage, it got our guest editors' gears spinning with ideas, and they delivered a

laundry list of materials that we could tape, glue or otherwise wrap around our electronics to toughen them up.

So, equipped with little more than the collective educated guesses of Jamie, Adam and our staff as to what might work, we bought three devices—a Dell Inspiron 1545 laptop (\$400); a Nokia 5310 phone (\$50 with T-Mobile contract); and a Nikon Coolpix S220 (\$150)—then made several trips to Home Depot, Staples and Sports Authority to pick up supplies.

Phone

Our theory was that the easiest piece of equipment to ruggedize would be our Nokia cellphone. Most mobile phones are built to withstand everyday drops and splashes. But we wanted a phone that could survive an angry throw across a room in response to a dropped call, and repeated dunks in water. Our first trick was to surround the edges of our candy-bar style cellphone with multiple large rubber bands to create a “bumper” so thick it bounced when we dropped it. Sure enough, when we tossed it into the wall, it bounced to the floor, but never broke or turned off.

For our first attempt at waterproofing, we wrapped the phone with a clear heat-shrink film designed for draft-sealing household windows, then went over it gently with a heat gun to mold it to the phone. We must have missed a spot, because when we dunked our Nokia, water leaked in and we were forced to perform an emergency shrink-wrap-ectomy to keep the water from shorting out the phone.

Obviously, we needed a more reliable solution, so next we tried vacuum-sealing the phone in a plastic bag using a FoodSaver device. The kitchen gadget was a bit too enthusiastic, however—it sealed our phone inside the bag and suctioned all of the buttons down at once, making it impossible to dial. We cut it free and retried the vacuum seal on the FoodSaver’s “pulse” mode, which allowed us to modulate the vacuum action. The results were good. Our bumperized, vacuum-sealed phone took all the impacts and water torture we could subject it to. But our solution was



Wrapping It Up

We tried several tactics to make our cellphone watertight, from vacuum sealing with a FoodSaver [1] to shrink-wrapping with plastic window insulation using a heat gun [2]. A dunk in a glass of water [3] showed which techniques worked—and which were full of holes.

inherently temporary—there was no way to recharge the phone without breaking the seal. Still, our fix would be more than adequate for a weekend boating trip.

Camera

Phones are largely solid-state products, with few moving parts to bump around, but cameras are a different story. With multiple lens elements and mechanical zoom components, even pocket-size digital

cameras can be fragile instruments. There are plenty of affordable, ruggedized, water-resistant cameras on the market, so we figured there had to be a way to build in this level of performance ourselves.

Waterproofing turned out to be the easy part. As watersports enthusiasts already know, zip-lock plastic bags provide a formidable moisture barrier, so just sealing our camera in a plastic bag made it dunkable.

Ruggedizing our Nikon turned out to be a far harder proposition. We made things difficult for ourselves by picking a camera with a telescoping lens, which needed special protection. We surrounded the lens with a section of small-diameter PVC tubing and glued a \$5 ultraviolet lens filter to the

KNOW YOUR STUFF

Tech Disaster File



Water

Everyone knows water and circuitry don't go well together. Funny thing is, pure H₂O won't harm electronics—it's the impurities that cause shorts. If you do dunk a gadget in the drink, turn it off immediately, remove the battery and let it air-dry for a few days.



Shock

Impacts do the most damage to glass and to elements that require precision movement (gears, hard-drive heads). Cameras and computers with spinning drives should be kept in padded cases when not in use. And if your digicam has a wrist strap, use it.



Dust

Sand and fine dirt are like water that never evaporates. Electronics that spend a lot of time in pockets can get clogged up with dust, which can jam up buttons, clog airflow and short out circuit boards. Take regular passes over your digital gear with canned air.

front of our barrel to allow for clearer shots than we were getting through our plastic bag. To protect the corners and edges, we used foam tape and weatherstripping, making sure to leave the flash and controls uncovered. Then we zipped the digicam back into its plastic bag, cut a hole for the protective lens barrel, smeared silicone around the seams and let it dry.

When we dunked it in water again, we learned an important lesson: Use silicone on both sides of any seal. Water crept in through our sloppy job and almost destroyed the camera. We had to remove it from the bag and leave it out to dry. When we did a more thorough job of silicone sealing, the Nikon survived its next submersion.

Our impact test produced mixed results. We tried drops from 3 and 5 feet to simulate the fumbles of the common klutz. The padded Nikon came through all of them without damage. But when we pushed our luck and dropped our camera from 8 feet, our UV filter shattered, and the shock gave the camera an irreconcilable "lens error." We accomplished our main goal of protecting against everyday acci-



Cutting to Fit
Cameras have lots of moving parts and fragile lenses. We padded our point-and-shoot as best we could with weatherstripping and foam tape, then surrounded the zoom lens with a section of PVC pipe. Applying foam tape can be tricky—we needed to cut around the controls and flash.

dents, but deep down, we had hoped to create a supercamera. We didn't.

Laptop

To be honest, we fully expected to destroy the laptop. A computer has so many fragile parts—spinning drives, LCD screen, open ports—that we had a hard time imagining an outcome that didn't involve a dustpan and a broom.

Our most basic goal was that our Dell Inspiron would be able to withstand a drop from a 3-foot-tall desk and a bath from a tipped-over cup of coffee. For impact resistance, we created an exoskeleton of foam-core

boards with thick foam weatherstripping on the flat surfaces, pipe insulation at the edges and halved tennis balls attached to the corners. Then we wrapped the whole thing in a foam-tape membrane. Airflow was an issue, so we carved out sections of foam over the intake and exhaust vents.

We initially shopped around for a molded silicone keyboard cover, but our Inspiron was new to market at the time and no manufacturers had a mold for it yet, so we cut a sheet of clear polyethylene to cover the keyboard and trackpad surface. Then we created a flip-up skirt from 40-mil PVC to shed liquid off the edges, while still allowing access to ports, plugs and the optical drive. Finally, just in case water still managed to threaten the sides of our laptop, we sprayed the USB, video out, and power ports with mineral-oil lubricant, then squished in two-part custom earplug putty from Ear Plug Superstore to create a DIY injection mold. When removed, these became perfect watertight plugs to protect all of the side ports on the machine.

Then we unleashed hell on our poor laptop. We dropped it from 2 feet, then 3 feet, then 6 feet, then 8 feet. Then came a tall cup of piping-hot French roast—with three sugars and cream. The padded Dell bounced back from all our drops, and the cup of joe shed right off the surface of the laptop. Through it all, our computer kept computing. Maybe we hadn't engineered the prettiest of solutions, but it sure turned out tough.

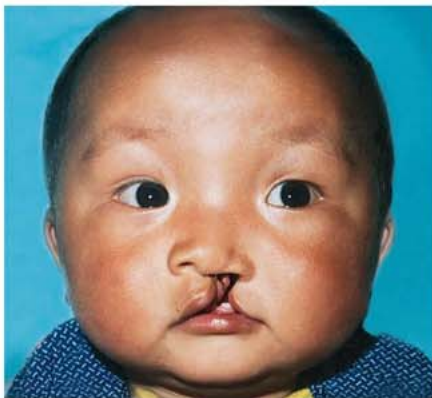
PM



Foam Is Your Friend

We put Jamie's tip into action, padding exterior surfaces with foam weatherstripping and pipe insulation, then taping sectioned tennis balls to the corners [1]. To create watertight plugs for USB ports, we used two-part custom earplug putty as an injection mold [2].

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Digital Clinic

by Seth Porges

Q + A



Select a Scene

HDR photography works best with scenes that contain varying levels of lighting, such as dusk landscapes or cityscapes at night.

1

START



Save and Share

The final HDR photo combines details from multiple shots.



2

Take Photos

Shoot at least three pictures of the scene with a range of exposure settings.

3



Upload Into Application

Load the photos into image-processing software to create an HDR image.

4



Tweak the Photo

Give the image maximum pop through an image-editing process called tone mapping.

5



The Surreal World of HDR Photography

Q I really like the striking, hyper-realistic look of high-dynamic-range photographs. How can I make these myself?

A The human eye is capable of capturing and processing a broad swath of light levels at any given moment. This allows us to look out on a world filled with bright spots and shadows, and to see an extraordinary amount of detail in

both at the same time. Compared to our eyes' Hoover-like ability to suck up light, most cameras can only capture a narrow range of luminance.

High-dynamic-range (HDR) photography is a technique for increasing the range of light shown in a picture in order to create vivid, page-bursting photos that exhibit a distinct, often exaggerated, level of realism. These photos are usually created by combining at least three photos of the same scene, all shot with different exposure settings. The final picture takes the best elements from each photo and frankensteins them together into a picture that has more detail and pop than is possible with any single shot.

This photo-mashing can be done

with Adobe's \$700 Photoshop, but unless you are skilled with some of the program's more complex controls, it's easier to use HDRsoft's Photomatrix Pro software (\$99), which makes the process virtually turnkey.

The first step is to pick your subject. The HDR effect looks best in scenes that have lots of shadows and highlights, such as outdoor shots at dusk or cityscapes at night (although portraits and indoor shots can look appealingly spooky). And if it's cloudy out, you can create dramatic, ominous images of cumulus-filled skies.

When taking the pictures, you'll want to follow what I call the Goldilocks rule: Shoot at least one photo that's overexposed, one that's underexposed and one that's just right. You can change the camera's exposure manually and shoot these separately (in which case you will definitely need a tripod, which is probably a good idea anyway), but if your camera has auto-exposure bracketing (or AEB), as most new digital SLRs do, it will be much easier. AEB allows you to quickly and automatically snap multiple shots with different exposure settings.

Once you've uploaded the photos, open up Photomatrix, click "Generate HDR Image," and select the pictures you want to combine.

Depending on how fast your computer is, the rendering process could take as long as a couple of minutes. And when it's done, you'll likely be less than impressed by the result, which will look murky and shadowy. That's because the new image is a 32-bit HDR image, and LCD and CRT computer monitors just aren't capable of showing the full range of luminance necessary to bring out all of the details hidden in these images' shadows and highlights. To turn the photo into a more useful format, you'll need to put it through a process called tone mapping, which brings

these details into the forefront.

You should see a window, "HDR Viewer," which contains a button labeled "Tone Mapping." Click it, and your image will finally be transformed into a cool-looking HDR photo. In fact, you could probably just save this photo and call it a day. But it gets better.

You should now see a new window called "Tone Mapping Settings." This window will have a bunch of dials with labels such as "Luminosity" and "Color Saturation." Playing with these will add life to your picture. Have fun pulling them in every which way and watching your picture morph from a

realistic-looking image into a surreal landscape. When you've got a picture you like, click the "Process" button, and the photo will be rendered to your specifications in a savable format.

One more thing: It's easy to overdo it with HDR, and professional photographers often look down on the technique as gimmicky—particularly when it's used to create shots that, rather than looking hyper-realistic, end up resembling crayon drawings. So while it's fun to crank up all the settings to their messiest max, be warned that such images may not get the best response from the photorati. **PM**

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4. Hydrocolloids Often called gums, these long-chain polysaccharides have been used in manufacturing foods for years. They are responsible for the foams, gels and sauces most evident in molecular gastronomy. Xanthan gum is a cold-soluble thickener that has replaced starch in Stupak's kitchen. The viscous gellan gum is boiled, hydrated and dissolved before becoming the restaurant's famous fried mayonnaise.

5. Dewar The restaurant keeps a 50-liter tank for liquid nitrogen, which can maintain temperatures close to minus 320 F. Why? For one thing, Stupak uses the nitrogen to create frozen honey.



Most chefs don't have scientists on speed dial—but then again, most chefs aren't Alex Stupak, who practices molecular gastronomy, or cooking with chemistry-lab-worthy techniques. At New York City's avant-garde restaurant wd-50, Stupak starts with a traditional dish, then designs something new—such as balsamic vinegar encapsulated in vanilla ice-cream nuggets—using high-end food additives and unusual equipment. The flavor combinations and textures are intriguing, and the food tastes great—which is what Stupak and his customers really care about. “With molecular gastronomy, people expect the unexpected,” Stupak says. “But if hydrocolloid gums and liquid nitrogen didn't exist, creative food still would.” — KATE SCHWEITZER

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